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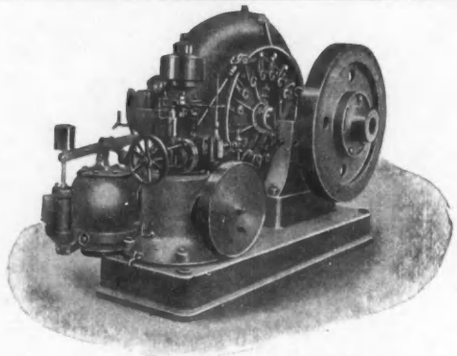

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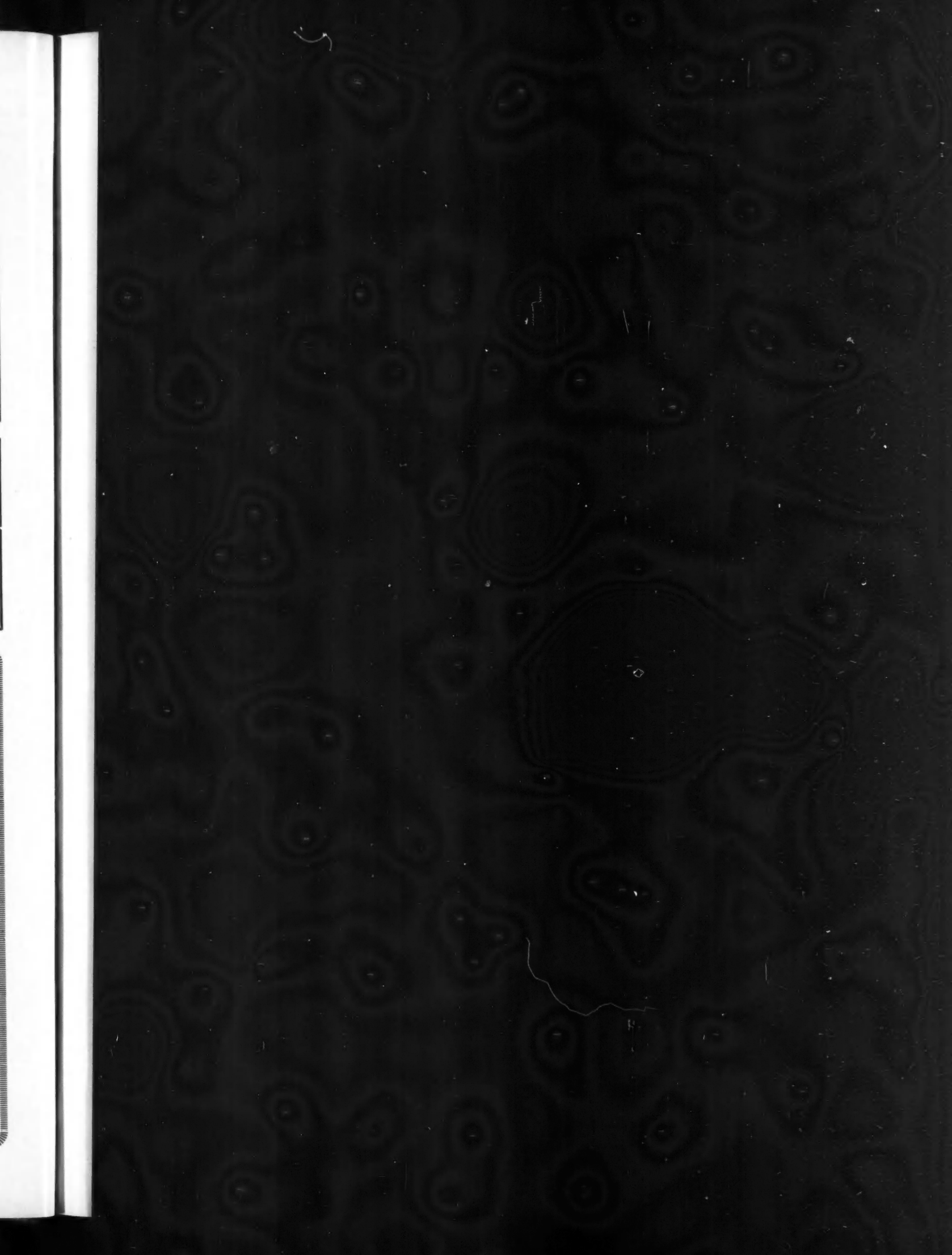

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HUME LAKE MULTIPLE ARCH DAM[1]

BY JOHN S. EASTWOOD.

Since the publication of the description of the multiple arch dam at Hume Lake, near Sanger, California, a number of suggestions and criticisms have been received from several engineers.

With regard to that of Mr. Hugh L. Cooper, it is pleasant to have one's work appreciated where the ring of it is genuine, and, as most of us in the profession are obliged to accept it at par as a part of our

Multiple Arch Dam at Hume, California.

At the outset I wish to thank these gentlemen for the kindly spirit manifested in the discussions and I will answer them in the same spirit, which it is the belief of the writer is the true spirit as between members of the same profession.

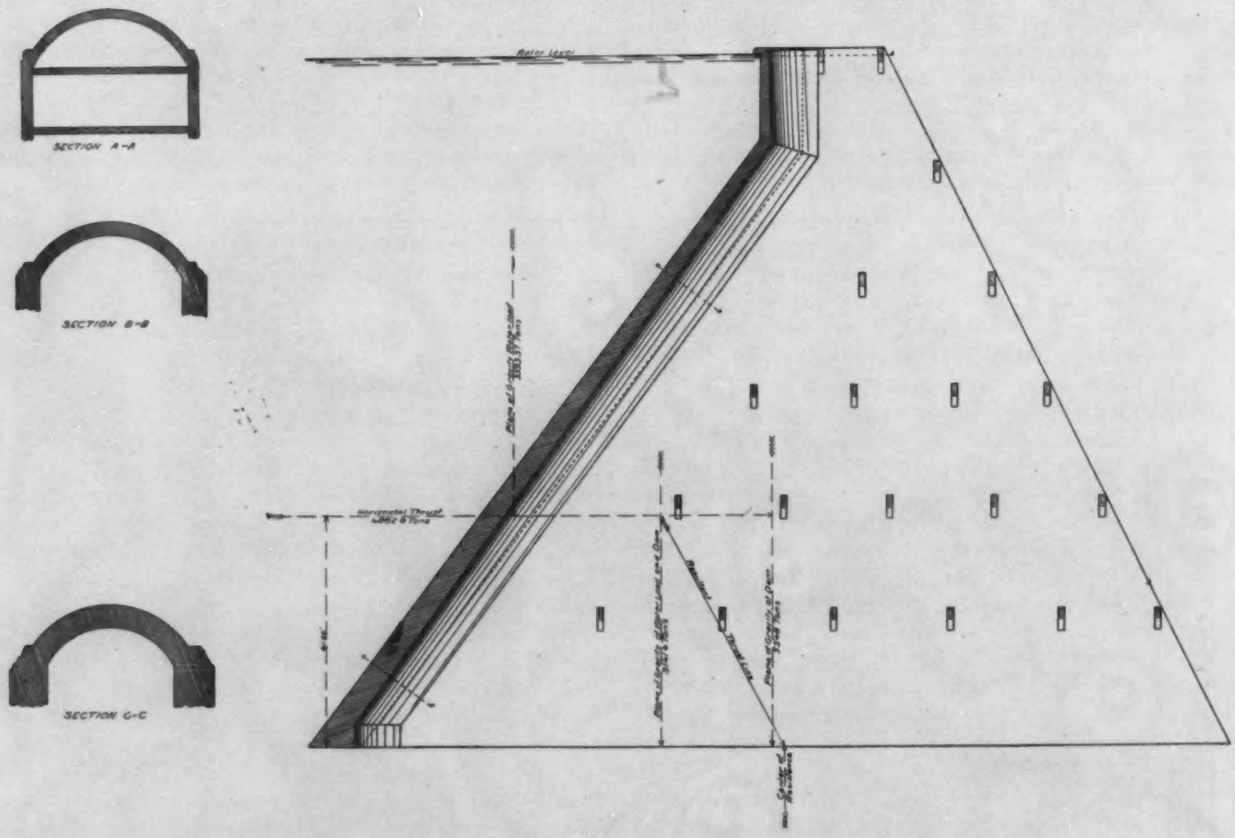
compensation, in addition to a modicum of coin with which to fight the wolf, to be of intrinsic value it must be genuine.

On the next page is presented a diagram of the resultant thrust of the combined water and structure load; its position relative to the center of resistance

[1] See Journal of Electricity, Power and Gas, Oct. 30, 1909.

ance of the base, and as the angle of friction of sonry surfaces. As the stresses at all points above the base are less than at the base, owing to a uniform taper from the required base dimensions to resist the loading to the top, where the mechanical requirements of a considerable thickness with no load are met, all parts of one of these dams are stronger than required except at the base, and it is for this reason that the best economy can be had with a reasonably high structure, wherein the influence of the required top dimensions would have the least influence on the amount of material. This fact makes it the type for any structure within the limits of dam construction, as it will dam, there being a discharge through the wasteway gates of over 4600 second feet, the highest in thirty years, sweeping the canyon below as clean as a shotgun barrel. Mr. D. W. Decker, manager of the Hume-Bennett Lumber Company, in reply to a query as to the effect on the dam, replied, "There is not a sign of a crack in it and it is as tight as a bottle."

When asked by the average citizen what holds the dam in place, I answer, "The water," and when they ask what I am going to fill it with between the buttresses, I answer, "Wind," this being the paradox—water to hold it down and wind to hold it up. But, persiflage aside, the very simple laws of hydrostatic pressure met with a provision for the equalization and



Stress Diagram of Multiple Arch Dam

not approach near to that of a solid dam within these limits, and that, too with safety factors unattainable in a solid dam.

The weight on the buttresses is the weight of the water due to its depth plus the weight of the part of the structure sustained, or is span x pressure + the resultant of the arch ring weight, all in similar units. The Hume Lake dam is overstrong in all of its elemental parts, the greatest stress being in the middle arch ring near its base, where it is 187.5 pounds per square inch, or 13.5 tons per square foot; consequently the weakest place in the dam is 100% overstrong, all the remainder more so.

The present season has also been propitious in furnishing us with a test flood for the Hume Lake conveyance of the stresses set up by them to the foundations is all the "bump" the mathematics get; the equable distribution and support of known loads well within the known strength of the material used.

In replying to the question of cost raised by Mr. F. O. Blackwell, I desire to emphasize that one of the principal advantages of this type of dam lies in the fact that for a given safety factor at the point of maximum stress, there is less material than in any other type for a given stress. This economy in materials leads to like economics in excavation, contractor's plant, crew, camp equipage, superintendence, and to the saving due to time saved in its erection, interest on uncompleted investment and putting into service, all of which offset the additional unit costs of placing the

material. It is not surprising that the unit cost was as low as it was in this case. The plant was all old except the cars and track, of too small a size for economy, and the power plant was of much-used logging donkeys, none of which stuff was up to the standard for a construction plant. With up-to-date apparatus, designed particularly for this class of work, the writer believes he could discount the costs of the Hume Lake dam by a considerable amount.

The form detail is shown in the cuts accompanying the original article, the form being built up ahead of the work so that the gangs would not interfere with each other. The method used, made the curved form work quite as simple as the buttress forms, the men erecting them as easily as a common house frame and boarding, much of the work being performed by common labor. The fact that lumber was but $10 per 1000 feet b. m., made it unprofitable to move any but the studs and one-inch boards in the buttresses and the liners of the curved forms, in so far as they could be used twice. The cost of cleaning, moving and refitting, considering the grit on it, made it so close as to be doubtful economy to move the forms.

As regards Mr. C. E. Grunsky's question as to the scope of this type, it is very much to be doubted if the failure of two structural dams make it wise to discredit all structural dams, the two cases cited being in both cases of avoidable reasons. These dams (the Pittsfield, Ambursen, and the Hauser Lake, steel) were both set on a water-bearing gravel stratum, and any other type would have been as great or worse a failure if set on the same insecure foundation (see Fergus' Falls dam). The very fact that a structure of this kind can and should be so designed as to distribute the load equally to all parts of the base makes it easier to support on a soft bottom than a mass dam. If cut-off walls are carried down to a sufficient depth, however thin the toe of the dam and weep holes provided in the base, there need never be recorded failures of this kind. Of course, solid rock foundations are to be preferred, and as they exist at most sites but a short distance below the surface, the very narrow cutting and inexpensive stripping should make it in most cases an easy thing to do right.

The matter of making concrete walls watertight is a feature that is dependent on composition and quality rather than quantity. Some instances of concrete tanks that are tight with water pressures almost as great as that at Hume Lake dam, though the walls are but eight inches thick, support this statement. With so many waterproofing devices in the market, many of which are of high merit and easily applied, it is rather more diffcult to decide between so many good ones than to make watertight the thinnest wall that is stiff enough.

The economical arc for the arch ring, like some of the other features of this type of dam, are determined according to a formula which fits the theoretical conditions of the factors from which it is derived, but which for practical reasons are at a slight variance from these in as much as their variance is affected by the requirements for mechanical reasons that do not appear in the theory.

Thus, while the economical arc for the Hume Lake dam, counting from center to center of the buttresses for the arc of extrados, based on a theoretical section, is about 136°, while for the heavy top it is found to give a very close result at 126° 28′, an angle obtained by taking the nearest even foot for the radius of extrados, the difference in quantity varying in so slight an amount for this variation in arc as to be negligible, while giving an even radius.

The filled between the arches is a feature that is for looks, as it does not add to the structure except by its weight, and hence is optional. The theoretical arc formula assumes the buttress and the arch ring to be sections required for the water pressure at the base and tapering to zero at the top, where there is no water pressure, the arc of extrados and intrados being equal, but in practice the altered batters to give a top thickness will make a different degree. The thinnest wall for a given thrust is at 180° of arc but it will contain about 8 per cent more material owing to increased length, being in a varying ratio to the decrease in thickness required for an equal load. The influence of the arch ring also affects the buttress thickness, and if an arc of 180° is used, the span must be increased to give the buttress its economical span load, owing to the change in the direction of the arch thrust.

The span is the flexible element in this structure and it puts it in a class by itself, the basis of the design being the concentric arch ring as a water face, allowing a closer adjustment of distribution of stresses while fitting the requirements of practice for such a structure.

The economical span is determined by the economical arch, and may be computed in terms of height or of span, the span being in even terms gives a multiple for spacing, the height in even terms giving odd spacing. All of these elements of the design must have a just weight in the design of a structure for any given site.

The slopes of the water face affect the quantities in the arch rings as indicated in Mr. Grunsky's table, due to the increased length of the arch, the least material being in a vertical arch and increasing in length as the secant of the angle of slope.

As the slope is influenced by a different set of factors, the economical slope for the theoretical section, varied by the other influences, is the slope for the practical structure, which is the one giving the mean of the influences of the requirement for stability, shear and distribution of stresses as well as the ultimate economy in quantities. The front and rear slopes required for stability will vary, the one increasing while the other is decreased for a given degree of stability, the increase of one calling for a decrease in the other in proportion to their degree of influence of the ultimate economical slope.

The tapering of the buttress from the water face toward the back while theoretically correct for a vertical face, becomes less with increase of slope, is counter to the requirements of keeping the center of resistance as far from the face as possible, and will not give the required shear strength. Hence is inoperative in practice, this also making the column method impracticable.

There should not be so wide a variation as from

1/5 to ½ of the quantities in a solid dam if a multiple arch structure is designed with due regard to the economics of materials resulting from giving to each feature its true value in the design. Of course there can be no question but that the unit costs for this class of work will be higher, a high degree of quality of materials and workmanship being required. But as the difference in cost between good concrete and bad or indifferent concrete made from the same materials is more a matter of good specifications and inspection than cost of materials, the greater part of the added cost being due to the form work and the difficulty of placing with apparatus designed for other conditions. The writer has gone quite thoroughly into the subject of the design of apparatus and forms, with especial thought to cheapen and simplify still more the construction of this type of dam, and is convinced that a still further reduction in unit costs is possible without any sacrifice of quality.

There is another paradox in this dam, that when it is fully loaded it is safest from stresses tending to rupture it, these being the temperature change streeses. Likewise when empty it is in greatest danger. We reinforce it with steel for stresses that can only take place when it is empty. If it were full all of the time it would not need any reinforcement as all of the load is in compression both full and empty, but when full they are an offset as well as a preventive of temperature changes.

Where the unit costs of concrete are high and the costs of steel are moderate the steel becomes as cheap as concrete in compression, and as it makes the structure safe from rupture, is advisable in any case of thin wall construction. The feature of using a water face, the material in which is all in compression makes the arch as a water face cost less than half the cost of slab construction for equal safe loads and spans, as well as putting the load on a material hunt by time, allowing other additional savings owing to its flexibility of span and reduction in number of buttresses.

These features place it in a class adapting it to a range of usefulness from very low structures to the highest that will be required for any site before its cost for a given strength approaches that of a solid type. It therefore becomes the logical type of dam for any height at any site.

As the critical point of stability comes in near the top, the vertical head is for the purpose of gaining width of top without adding to the buttress width of top or changing the batter of the back line of the buttress. It is a feature of the Hume Lake dam that is more prominent because the span is large. It is higher than it would be for a smaller span and is a larger proportionate part of the dam. The lack of rise in the economic span for a high dam requires the reduction of head as well as the increase in width to the buttress top. The head should be a curve on the extrados crown line, but the limitations of practical forms must be recognized and the structure made to fit as nearly as these will permit to the theoretical skeleton.

The Hume Lake dam, while 87 per cent overstrong for its service, using Mr. Grunsky's figures of 350 pounds per square inch in compression as a basis, is still a symmetrical structure in the main features, the departures from the highest safe economy being due to the service it is to perform. The spillways at the middle are to allow the use of the ground at either end as building sites for the mill and shop. As the openings cut out so much of the arch it necessitated the heavy walls. The fact that Sequoia logs 14 ft. in diameter are to be handled over it and in the pond, led to the design for an excess of strength.

The only redundance or of parts not in full service are those for eye sweetening the design, such as the filler, the coping and the wing buttresses, all of which are of more or less service in addition to what they could have as a part of a solid type, for stiffening, where such stiffening is of value to the structure.

Mr. Jorgensen is correct as to the economical arc for the theoretical structure. The formulae for this computation depend on whether the arch is supposed to include the triangular end of the buttress or whether the buttress is considered to be cut off at the spring line of the intrados of the arch. The result is the same in any event.

The economical arc will vary with the depth or water pressure, but as it will complicate the design to vary both the arc of intrados and of extrados, the economic arc for the practical arch is best taken as the mean of economy for the structure, the economic arc for the mean mass depth, this adopted as the extrados arc, letting the variation take place in the arc and radius of the intrados.

The theoretical arch would have to vary at all points in all of its elements and would complicate the design to the extent of making it more difficult to erect than the saving in material would warrant. There will be cases where a less arc will be more economical, such as where the least allowable thickness is in excess of the required strength at the ordinary economic arc, in which case an arc to fit the stresses is to be chosen.

Mr. Jorgensen has also struck the keynote of the principle of the design of this type of dam namely: load the entire structure to its greatest practical economy, getting the best efficiency with the least cost.

Mr. Wegmann's citations of the examples of works embodying to a more or less degree the principles of the arch in dam construction are interesting as showing how old the first conception of merit in the arch really is, of the problematic value of a patent on such a device. All of these earlier attempts at the use of the arch, which the writer hereby admits were rays of light on his patch, were the gropings for the structural idea in dam construction, and were indices of the direction in which to look for the ultimate structural type.

The earliest example was wrong in that the axis of a multiple arch dam should be straight instead of on a curve up stream, or if curved it would be better if curved down stream as adding to its stability, owing to the uptilting of the buttresses on the sides rather than the placing of them on an incline by the reverse method.

There is this to say about these earlier plans and works, they are all based on the idea that the water loaded arch is subjected to the same stresses as are set up in an arch when used as a cantilever or beam with a distributed load, and an arch designed in this form is not the true form, as the material outside of the crown

line of extrados is not only wasted and an added dead load, but the change in the direction of the thrust line reduces the efficiency of the materials making it a bracketed beam and introducing tension.

The Dillman design was good as showing the feature of cutting out a part of the material by widening the base, the water face of the arches being a vertical slab, the arch intrados eliptic, the buttresses tapering to the back. But it was only a step ahead, the same fault of making it a mere obstruction remaining and the stresses not being all compressive. Neither was it possible to give it an even base load any more than it is possible to give a solid dam a distributed base load. For this reason there is no doubt but that a buttressed dam 160 feet high with vertical arches would show but a small percentage of saving over a dam of solid section because it is the adherence to the old idea of the imposition of mass to resist a thrust instead of designing a structure to carry this thrust as a load to hold it in place.

While the structural principle is not so pronounced in the Hume Lake dam as it would be in a structure 160 feet high, it is because the heavy section and large spans due to the low head decrease the required slopes. The vertical arch is applicable in the multiple arch dam to such parts as are below the economic height for the head in structures where parts are high, and also for all arches where the height is such that a large span must be used for economy and for site where the canyon walls are close enough and steep enough to serve as abutments where they can be used to any required height.

This type of dam differs from the Ambursen dam, as shown in the reply to Mr. Grunsky's discussion, and as shown therein is not subject to limitations of height.

The writer, anticipating this question of watertightness has devised a method of making a practical watertight wall, regardless of water pressure or thickness of wall required in this type for the load stresses.

There is an erroneous idea as to the difference in the unit quantities in this type of dam and a solid type, due largely to a mental habit of classing it in with all other hollow types, instead of comparing it as an individual type. Mr. Grunsky places it at from 20 per cent to 50 per cent and Mr. Wegmann at from 85 per cent to 90 per cent of that of a solid dam but in so doing they are not comparing this type, but the design they have in mind, their own, which is not of this type.

To illustrate, the entire 2207 cubic yards in the Hume Lake dame, + 10 per cent to approximate the larger figure, = 2408 cubic yards. A solid dam would approximate 75 cubic yards per lineal foot of dam across the middle section of Hume Lake dam, and 75 into 2408 is 31.4 = the number of feet the quantities in Hume Lake dam would build of solid dam at the same site, and yet the Hume Lake dam, 667 ft. long, contains an excess quantity, based on Mr. Grunsky's allowable stresses, which are very conservative, of 87 per cent at its weakest point.

Because there is such a marked difference in quantities, the quality of the materials and workmanship can be made first class, the safety factors in all of its parts left far above any possible requirements, and still bring the cost far below that of any other type of structure for the service required.

CO-OPERATION BETWEEN ELECTRICAL JOBBERS AND ELECTRICAL CONTRACTORS.[1]

BY FREDERICK BISSELL.

Co-operation, much to be desired, certainly possible and the aim of all men who are thinking earnestly, outlined by your own resolution which says that the natural course of merchandise is from manufacturer to jobber, then to the contractor, central station and others, and then to the consumer. And to this policy are committed both the jobbers' and contractors' association and everything possible is being done toward this end.

That it is advantageous to the contractor to buy from the jobber is an old statement and grows stronger every day. The time worn story that the jobber does concentrate merchandise, making a depot from which the contractor can draw assorted items on demand, that he makes a few shipments of many items, that he can always offer good railway facilities because jobbers are found only at points having such facilities, that the contractor needs no large investment in merchandise and can devote his capital to other necessities in his business and that he can and does on occasion receive financial favors—all these things are true and are better understood every day.

We recognize that there are advocates of other policies who disagree from this but with the changes constantly making in all parts of the business world, and which are very active in the electrical field, it is certain that the jobber who fits himself to properly handle the contractors' business and who treats the contractor justly will always have his own reward.

That many things are now in the wrong and that we are far from the ideal is obvious, yet we believe that the trend of opinion and of events is in the right direction. The thing to do is to get together, but it is much easier to outline the present defects and the future perfections than it is to tell how to avoid one and to reach the other.

One of the first troubles is found in the jobber who does a construction business or runs a construction department and for a reason in which he is sincere and which is generally based on some local condition. This method is not approved by jobbers in general.

Then there are contractors who attempt a jobbing business, and for reasons equally sincere and to them equally satisfactory yet who retain their construction business. Both of these men are detriments to their respective associations and have been the causes of the most serious obstacles in the working out of this problem. If such a jobber be asked to cease construction or the sale of merchandise to isolated plants, he points to the contractor who is striving to retain his construction business and yet get into the jobbers field. And to make his argument entirely sound from his side he will attempt to prove that the contractor is always the one who is trying to buy direct from the manufacturer and to cut out the jobber. This same contractor brought on the carpet for his sins, points to the jobber who still retains a construction department and because the pot and the kettle are both black they soil everything in reach.

[1]Paper read before the Toledo Convention of the National Electrical Contractors' Association, July 22, 1909.

The contractor points with disgust at the curbstone operator with the proverbial screw-driver and coil of annunciator wire and is unable to appreciate how the little fellow can get stuff at the big contractor's prices. Yet he fights vigorously and some times viciously against a quantity price, himself endeavoring to buy one at the price of one hundred, has plenty of reasons why an initial price with rebates for quantities purchased in a given time is all wrong, and in other ways obstructs plans which, possibly imperfect, yet have the merits of being honestly designed for the protection of the big buyer without forgetting justice to his little brother. There is not a man in either association who was not once small and who was entitled to and had his chance and the right to prosper, if he showed ability and nothing short of that is thought of today. Nor will the economics of business, regardless of legal objections, ever permit anything different. The price for quantity always has made a difference and doubtless always will but what can be urged further than that, what distinctions may be made to conform to divisions of business, no one is prepared to say.

We repeat that the contractor who avoids the jobber, and the contractor who tries to become a jobber and a contractor at the same time—and the jobber who does contracting—are alike equally guilty of being obstacles in the road of co-operation. Too many irons in the fire is bad practice and few can keep more than one hot at a time. If many irons be possible what is to prevent the growth of an octopus who will manufacture, job, retail and construct all over the country with branches in all important points, big and little? What is to prevent this octopus from incidentally absorbing the central stations too with departments for installing door bells? Are we drifting that way?

Suppose the contractor has a scheme to eliminate the jobber and is successful. The jobber promptly retaliates, engages in construction and the latter case is worse than the first. Trouble from this source is already on us and, in some localities, the line of demarcation between jobber and contractor is very dim. All results are warnings in favor of better co-operation.

Along this line of investigation it may be well to ask if the jobber is really a business necessity. No doubt exists in the minds of the jobbers themselves, although there have been some manufacturers and some contractors unkind enough or misguided enough to regard the jobber as not an absolutely essential member of society. For those who entertain such ideas it may be well to remind them that no one who is useless endures. The progress of events takes him out. Yet from the earliest history merchants who bought in bulk and sold in broken lots have been prominent and doubtless always were dominant in the business world as they are to-day.

Some things do today go from manufacturer to consumer, but not very many. Judged from everything the jobber is here to stay because he is a truly useful member of business economy, and when he ceases to be useful he will vanish. It may be helpful to appreciate that vanishing is not a monopoly.

This same question of being a business necessity may with equal propriety, and possibly with more justice, be put to the contractor to ask him his reason for being on earth, and the answers are alike—that too many irons in the fire is bad practice, and that each division of business needs its operators, and that contracting is a necessary business division.

Once more to review, it is true that if the contractor's goal is to be the construction business, he needs the jobber; but if he aims to be a jobber himself, he needs the manufacturer. Then when everyone becomes a jobber, what happens?

What is to decide a contractor in his plan? Where does he look for an example? The relations between the manufacturers and the jobbers are not perfect, but that is another story. It is, however, as good as the relations between the jobber and contractor, but the relations between manufacturer and contractor are certainly bad enough to excite the condemnation of every thoughtful man. And right here we put our finger on the source of many of the reasons why the despised curbstone operator does not stay where you say he belongs.

Again, the contractor argues forcibly that he deserves a percentage on his material, which all jobbers cheerfully admit and endeavor to provide, but is it equally true that all contractors admit that the jobber is entitled to his percentage? No one expects to lessen the energies of an active buyer. Yet it does seem that when a man buys as low as any one in his class, be he jobber or contractor, that he should be satisfied and then endeavor to make a profit on what he has bought. That this delightful condition does not exist we know only too well.

One betterment which is coming rapidly is in improved internal business methods. Both jobber and contractor are keenly alive to these. The better methods include buying with regard to the profit which can be made when the goods are sold; better bookkeeping, collecting and paying; fewer open accounts either way; selling goods and doing work only when a profit can be made; and along these lines success is certain.

Lately much attention has been given to just these things in the grocery trade, a business where the retail condition for years has been unsatisfactory, where the manufacturer has insisted that by liberal advertising he could create a market and compel the retailer to handle his cereal, or tobacco, or whatever it might be. And now we see a movement started in St. Louis where members agree to sell only such goods as pay them (the retailers) a profit.

The store counter trade in the electrical business is happily in no such straits as this and is a feature to which much attention can be given. The same methods which are successful in other lines apply directly here, and, if it is true that the cigar business will justify the lease of a skyscraper just to get control of the corner store on the street level, it is certain that something in a retail way can be done in the electrical business.

This requires a selling organization consisting largely in promptly answering the telephone, keeping the store new and bright, reasonably good window and counter displays, cleanliness of store, proprietor and clerks, knowledge of the business, unfailing courtesy and reasonable advertising.

Our company has asked each of our salesmen to read the article on the cigar stores which appeared in the Saturday Evening Post of July 10th, in which all this is put out in excellent detail and is well worth the time of any man who does any retail business.

Perhaps the greatest enemy to the contractor's success, particularly if he is a retailer, is the unwise attitude adopted by some central stations in giving away articles which consume current. For this there is no reasonable defense. Many manufacturers protest against this with varying vigor, but some absolutely prohibit the slaughter of their articles which are controlled by patents.

To one central station who offered to do big things for one manufacturer and who was entirely earnest and well able to carry out his suggestion, the manufacturer argued that instead of killing the article, why did not the central station take it out of the price of the current, which to him seemed the reasonable way to promote the current business. This was refused. Yet we all know that it is the right way to increase consumption of juice, as witness the power companies supplying current to big mills and factories. The consumer is waking up to the fact that he is the victim—that the present of a flat iron on a high rate is loaded and sure to explode and take a few of his fingers along with it.

Yet the central stations have some proportion of reason when they say that they are forced to do these things because contractors do not run retail stores, do not promptly take up with new ideas, some times attach too high a percentage of profit and thus kill the introduction of new devices, and other arguments with which you are familiar. The question for us is, are these arguments sound? If they are we must permit the central stations to go ahead on almost any lines they choose, for we neglect the business and they have a right to it. If, however, we can show them that the sale of current consumers is actively solicited in their city by one or five or fifty contractors, and that collectively much more is done than the central stations could accomplish with its own corps of salesmen, then we at least have the opportunity to prove to the central station that such methods are neither necessary nor profitable to them. This situation for the contractor and central station parallels that of the jobber with the manufacturer who goes direct to the consumer or to the contractor. Both methods will cease when they are no longer necessary. It is what men do, more than what resolutions they make, which determines business methods.

Now, what is the general situation? Must we all continue until the electric business looks like the market for patent medicines, where the jobbers pay 60 cents for a bottle which retails for $1.00, yet the consumer can buy it from the department store for 58 cents. If so, what is the use? But we have unbounded faith that this is not so; that not only the nature of this business, but the class of men in it, will find ways to make money proportionate to the investment and the efforts which are now in it, and that these are great is well recognized.

A manufacturer cannot be a jobber nor a contractor nor a retailer unless he assumes all the responsibilities, risks and expenses which go with those divisions of business, and when he does assume them the exclusive jobber and the exclusive contractor can always beat him. And we have the further advantage of the effort and experience in other lines, like the grocery trade referred to; their troubles extending, as do ours, straight back through the jobbers and the manufacturers. The Woolson Spice Company disapprove entirely of those jobbers who roast their own coffees and grind their own spices, and they have other troublesome questions, as we do. Truly, we are not alone and the experience of others will at least be helpful, if it does not show us the way clear out.

That there is a way to arrange these things to the mutual advantage of all concerned, and that the way will be found, is a certainty. Just how, we do not know, although we are here to welcome and adopt any feasible plan, even if it is only one step in the right direction. Perhaps these betterments will first come locally and later will be universal.

Who will take the initiative, or who can take it? We must start somewhere. Who will clean house, learn what can be done and be the first to do it? It is not only a question of who will, but also who can.

To go back to the beginning of this talk, it is easy to see the many advantages for us all. Those who have really thought on this subject recognize that it must be mutual. But when we attempt to reach this promised land we find as many obstacles as Moses did. The solution will come along economic lines and will eventually take care of itself by the survival of the fittest, which is not saying that the contractors shall devour the jobbers; or contrarywise. It does say that each will find his proper place much quicker through co-operation than through strife; that we are made for each other, and instead of many offensive alliances with others, we should have one defensive alliance for our mutual benefit.

Meanwhile, the man who goes with his times, who is able and active and earnest, and who endures, can and will make money in the business of electrical construction.

Advertisements in telephone directories roused the ire of business men of Fond du Lac, Wisconsin, who appealed to the Wisconsin Railroad Commission to compel the Wisconsin Telephone Company to furnish directories free from advertisements. This was on the ground that advertisements of foreign and local firms hurt the business of the petitioners. The Commission wisely refused to interfere in the matter and further decided that, "any act, practice or collateral, undertaking of a public utility company, not affecting prejudicially the reasonable performance of its duties and obligations to the public and individuals, although displeasing to some of its patrons because tending to prejudice in respect to their private interests, is not within the scope of the regulative powers conferred upon the commission, that the universal practice of telephone companies of using their directories as advertising mediums is a practice collateral to the public functions of such companies; and as long as not interfering with the discharge of such functions, is not within the regulatory powers of the commission; that the respondent furnishes adequate directories to the petitioners and to the public and the use of the same as for advertising purposes does not impair its serviceableness to the public."

UNDERGROUND ELECTRIC CONSTRUCTION.

Discussion by members of the San Francisco Section of the A. I. E. E., December 17, 1909, of paper read by S. J. Lisberger and published in this Journal, October 9, 1909. The following participated in the discussion:

George R. Murphy, sales engineer, Pierson-Roeding & Co., San Francisco, Chairman.

L. E. Reynolds, Oakland, Cal.

A. J. Pahl, foreman, underground department, City Electric Co., San Francisco.

Geo. C. Holberton, engineer, electric distribution, Pacific Gas & Electric Co., San Francisco.

C. J. Wilson, superintendent, electric department, Oakland Gas, Light & Heat Co., Oakland.

S. G. McMeen, engineer, Home Telephone Company, San Francisco.

C. L. Cory, professor of electrical engineering, University of California, Berkeley.

L. R. Jorgensen, designing engineer, F. G. Baum & Co., San Francisco.

S. J. Lisberger, engineer, electric distribution, Pacific Gas & Electric Co., San Francisco.

H. Y. Hall Jr., assistant electrical engineer, Southern Pacific Co., San Francisco.

A. H. Babcock, electrical engineer, Southern Pacific Co., San Francisco.

H. W. Mozier, superintendent, steam plant, Oakland Gas, Light & Heat Co., Oakland.

H. L. Worthington, general foreman electrical distribution, department, San Francisco Gas & Electric Co.

L. E. Reynolds: I was interested in the first installation of the "Independent" system in San Francisco, and I wish we could have ideal manholes as Mr. Lisberger has shown tonight. There are a good many places where the streets will not permit of them, because of pipes and other obstructions, but time will work out these and other problems, and I admire the paper as a very good description of an underground system. I would like to have Mr. Lisberger tell us more in detail of the high tension apparatus, or possibly Mr. Pahl could let us know what is being done in the City Electric system, exemplifying the same in a slightly different way. I would like to hear about some of the troubles they have had under their conditions of operation.

A. J. Pahl: The City Electric Company uses 3-phase. 4-wire 11,000-volt grounded neutral system of distribution for both overhead and underground. The system consists of a network of lines and cables which are separated by switches, and each section controlled by a feeder. These are arranged so that any section or feeder can be cut out and still keep the balance of the system alive.

In the underground districts 3-phase cables are run. These are divided into sections by special water-proof 3-phase oil switches. At the intersection of the side streets off Market street taps are brought out of the main cable, and that street is fed single-phase at 6400 volts. Alternate taps are brought out of this cable.

On the main side streets single-phase cables are run direct from the sub-station. There is a sub-station in the downtown district for generating direct current for elevator and power service. The sub-station is also a switching station for the downtown feeders. With this voltage no transformer sub-stations are required, and the entire city can be fed direct from the power house.

One of the main features of the system is the oil fuse and switch. This consists of a cast iron box about 9 in. x 9 in. by about 20 in. long. It is filled about two-thirds full of oil so as to allow plenty of air space for expansion. The cables are brought into the box through special porcelain bushings under the oil, and wiped to hose nipples on the outside.

The fuse arm is controlled by a shaft through a stuffing box on the end of the box. The fuse arm can be raised clear of the box so that it can be operated without danger to the operator. This box is used both as a fuse and switch to control branch lines as well as transformers. These fuses have operated under short circuits, and no damage was caused.

The system has been in operation about two years, and there has been no trouble with operating at this voltage. There have been but two cases of primary cable failures, and these were due to poor workmanship on the part of the splicer.

The operating is more simple than with the 2200 volt system. There is only one hot leg to be taken care of, and the workman never works on a live part. Enough section switches are installed so that any section can be cut out and fed on the secondaries during the day time.

The primary drop is very small, and by proper distribution of the transformers very good regulation is obtained. Besides the flexibility of the system it is very economical in the use of copper, and the best results have been obtained.

Geo. C. Holberton: It is a little unkind of Mr. Reynolds to talk about the troubles of the City Electric so soon. We, however, have had lots of trouble, as Mr. Reynolds knows better than I do, because we have been in operation a great many more years. After the fire we certainly had a very serious condition of overloads on various cables, due to the fact that in a few days the entire condition of the load changed, that is to say, where we were provided with plenty of cable capacity and were able to take care of the business we had no business; where we did not have the cables we had lots of business, and we certainly sat up nights and tried our best to keep things going. However, that condition has now been rectified, and we have a system of distribution which meets with Mr. Reynolds' idea of ideal manholes. Mr. Worthington (who is here) has been working several years gradually cleaning up and putting the manholes into this ideal condition, and we find it certainly pays. Our manholes now have all been cleaned up, all surplus material and unnecessary boxes (if there were any) removed, and the whole system simplified as much as possible.

In reference to the Edison tube that Mr. Lisberger spoke about I think that that has been abandoned practically everywhere. We still have a good many miles of tubes, but we know that it is in bad shape and must in a very short time be taken out. That is due largely to electrolysis and local chemical action which has eaten off the metallic container, so that that coupled with the overloads that the Edison feeders have had to carry, means that it must ultimately be replaced by some form of draw-in system.

Going back to the paper as presented, there are some points that I would like to bring out. For instance, if any of you should go up against underground ordinances as drawn up by the cities, it is well to bear in mind the following: In the first place the former method was to create an underground district, and state that the wires must be placed underground within a certain time. This is, from the company's standpoint, the wrong way to look at it; and the proper way to word this ordinance is to state that the poles and wires must be removed from the street in that district. That gives you a chance to avoid in many cases the installation of an expensive underground district. At the present time the sentiment against the overhead wire is very strong, and the matter has been carried to an extreme, and underground districts have been created where you cannot lay out an intelligent underground system, due to the fact that the existing buildings are of a temporary nature, and you cannot see far enough ahead to know how you are going to get the load; and in that case you can often feed into the buildings from the side streets, and in that way avoid entirely the necessity for an expensive and permanent underground structure, and that is really better, not only from the company's standpoint but from the city's standpoint. If an underground system such as Mr. Lisberger has described were to be installed in some of the underground districts today it would not

be more than two or three years that you would have to abandon some of it, and add to the others, which means tearing up the streets, and is certainly objectionable. To illustrate, in San Francisco, for instance there are sections of Fillmore street consisting entirely of wooden buildings of a temporary character, and which will undoubtedly be abandoned. In these districts we have been able to remove the poles and wires without the necessity of going to the expense of putting in an underground system and tearing up a street which has not been improved for more than eight or nine months. This has been done in a manner similar to that described by Mr. Lisberger, when he spoke of leading wires from the manhole up the face of the building. Instead of that we merely bring the iron conduits around the corner of the building to the side street. As that work is now done in a substantial manner with either condulets for outlets, it is a great deal safer than some of the work which is permitted in underground districts, and the methods which we used have been inspected by the department of electricity, and approved.

C. J. Wilson: Mr. Lisberger did not mention the protecting of the cables by the use of asbestos tape, which is wrapped around the cable sheath and then cemented with some silicate solution, which hardens very quickly and makes a very good protection to the cable, and also protects any of the adjacent cables in the case of a burn-out.

We have just completed a district in Oakland where we were directed by a city ordinance to remove the poles from the streets, and I think everybody interested in Oakland will see that it is quite an improvement.

S. G. McMeen: Mr. Lisberger's paper has such a practical nature that it is of great interest to all of us who have to do with conduit systems. There are certain striking differences between such a system as he has described, and one which serves purposes of electrical communication. Perhaps the most marked difference is that in the communication systems as ordinarily designed, there are fewer kinds of things in the manholes. In a modern telephone system, for instance, in other than the most congested centers, distributing terminals, protective apparatus and translating devices are not found in manholes. Such a manhole usually contains cables and splices only.

Mr. Lisberger speaks of the difference between brick and concrete manholes being principally one of strength and watertightness. On the Pacific Coast there is a further important difference; that of cost. If one considers the cost of the quality of brick best suited for a manhole, he will find that on the Pacific Coast the cost of the brick alone is about as great as the completed concrete manhole, not counting cover and frame. The cost of the cover and frame in position is about the same for other construction. One of the usual advantages of the concrete manhole, in that it can be made in a standard form, is not as adaptable to city conditions as might be wished. In downtown San Francisco, for example, the size and form of a vault is controlled so much by what is found in the street that the use of standard forms for concrete pouring is the exception rather than the rule.

As the accessibility of the various forms of splices in the vault of a telephone system is a matter of great importance. it is found an advantage to limit the maximum width of the conduit lines to four ducts. With this construction the four cables entering a vault in a layer may be divided into two pairs, and the cables carried around the sides of the vaults only two wide on a side. Under proper conditions, limiting the width of the conduit line to four ducts makes no substantial increase in its cost as compared with greater widths.

The method of supporting cables in vaults, as described by Mr. Lisberger, involves placing the sleeves for the cable-supporting pins at the time the concrete is poured. In some circumstances this may not be done, the sleeve for the cable-supporting pin being placed in a hole drilled afterward. We have lately had occasion to drill many thousand such holes, and have found most useful a compressed air drilling outfit. This consists of a gasoline engine and an air compressor, with air, water and fuel tanks, all mounted on a proper truck. The cost of drilling holes for cable supports with such a pneumatic drill is so low as to compare favorably with the cost of placing the sleeves at the time the vault is poured.

G. C. Holberton: The practice here is to make the ducts as tight as we can, but all the ducts have a slight grade to drain the water to the manholes. Our standard grade is 4 inches in 100 feet. That is about the grade we give the ducts. I regret very much that Mr. Lisberger has shown a picture of a very improperly constructed trench in that he shows bridges. The ditch should be opened up clear through, and no bridges allowed. You never can fill a ditch with bridges as well as a ditch that is open from manhole to manhole.

C. L. Cory: I could not help thinking this evening, while Mr. Lisberger was reading his paper, of an article I read a good many years ago about the difference between the light of the tallow candle, where the generating station at the place of consumption occupied a space of one cubic inch, and the present systems of illumination, where the generating station may be a great many miles away, and the innumerable points of consumption are a very great distance from the source of power. When one thinks of the number of links between the central station where the electricity is produced, and the different consumers, the problem of maintaining continuous service must impress itself upon us.

I suppose there are a number of us here this evening that can remember the time when all of our interests were concentrated in the generating station, and almost confined to the device which was used to produce the electric energy, its efficiency regulation and so on; but as we know now, the generator is but a small part, and it is by the development of the art, the changing from the old overhead work to the underground construction, and the introduction of the most efficient means of utilizing the electricity, that we begin to attain the highest over all efficiency.

Mr. Lisberger mentioned this evening one thing which is quite true—the difference in simplicity between the distribution of direct current and alternating current. And yet, when we think of the extent of alternating current distribution—we heard this evening of one at 11,000 volts, 6400 volts between conductors and earth—the transformations of voltage, and the many uses to which the current is put at different voltages—we must admit that the alternating current system of distribution with transformers is most satisfactory.

There is one thing I could not but be interested in this evening. It happens that it has fallen to my lot at times to represent municipalities in which certain ducts were to be set aside for the use of the city; and it was assumed that the employees of the city might work in the manholes installed and used principally by public service corporations. I don't know that my attitude of mind would be appreciated by those who have to do with the building of these manholes for the corporations; but it always seemed to me that the manhole in connection with underground construction should be just about as sacred as a bank vault and that nobody should go in there and do work unless it be under the supervision of the man who was responsible perhaps for its design and construction and continuous operation.

Just one other word regarding underground systems replacing older overhead systems. As Mr. Holberton and Mr. Wilson perhaps remember, I have been called upon to look over certain installations or certain services where almost without any warning it has been necessary for the power company to transfer the service from overhead to underground; and while Mr. Lisberger has given us a very complete explanation of the ideal manhole, as Mr. Reynolds might put it, and the construction of an underground system, yet even after that is done, it is really of a somewhat important character and a difficult accomplishment to change the service from the old overhead service to the underground, and yet get the sort of installation which shall be satisfactory in every particular; and I am quite in agreement with Mr. Holberton that in many instances the requirement

of the community, whether it be by the supervisors or the councilmen, is one almost impossible of accomplishment; and I think that engineers in general should bear this in mind. We cannot help but remember that the business of the serving company is to deliver to the consumer that which is required, whether it be telephone or telegraph service or electric light or power service; and as far as the customer is concerned, often he is not willing to give the serving company credit for the difficulty which may be encountered in giving service. And so it is I think that many times we are inclined to feel that these almost sweeping changes are demanded so quickly as to make it almost impossible for the company to do the work as it ought be done. The idea of taking a certain district, and saying it shall all go underground, as Mr. Holberton said, is a very different thing from saying that the poles must come off a certain street. Whenever engineers have anything to do with such matter we should bear in mind that there is often other methods which may be used besides putting everything underground.

L. R. Jorgensen: Mr. Lisberger has covered his subject quite completely, and deserves much credit for having given out the accumulated experience gained by doing underground conduit work on a large scale. I think we can all appreciate what a big corporation is up against when the city compels it to put its wires underground in ducts, as these ducts are often as costly as the wires themselves. The city supervisors in many places have the idea that it does not look good to have the wires up in air (laughter); they think people should be able to see the sky, even when walking on Fillmore street. (Laughter).

Incidentally there are several other advantages in putting the wires underground, even if it is costly. If done in the way Mr. Lisberger has described, it is permanent construction so far as the ducts and manholes are concerned. The cables of course are not altogether out of danger from burnouts, grounds, etc., although they are pretty well protected in the ducts, and faults should not be as difficult to detect and to repair as with the Edison tube system, which system perhaps is cheaper to install but more expensive to maintain, especially where the outside pipe is subject to the action of electrolysis. What the proper depreciation charge for the Edison tube system will be Mr. Lisberger has not told us. I should think between 5 and 8 per cent. I do not figure depreciation in exactly the same way as the speaker at a recent institute meeting here. If you put your pipes in the ground 40 years ago and you go and look at them today, you will hardly be able to see them for dust, even if the cost of construction was a million dollars. (Laughter).

The clay duct system is the most substantial, and outside the cables there is not much that can depreciate, and if a bare copper wire is run alongside of the cables, and the lead cover tied to this wire at intervals, in the manholes for instance, there is not much chance for electrolysis eating through the lead cover. It is understood that one end of the bare copper wire should be tied to the railway return circuit causing the trouble as near to the railway power station as possible.

As to the system of wiring we have seen that the service mains run in the same line of ducts as the feeders, and that the service connections from the mains are made either from the manholes or from handholes located at convenient places between the manholes. The size of the feeders is easily determined after the load is estimated or calculated and the drop fixed for example at 10 per cent. The size of the distributing mains are more difficult to determine, as these are fed from both ends and current taken off at different places throughout their length. The amount of current flowing from each end is found in the same way as the reactions of a loaded beam supported at both ends. Then the point in the main where the currents from both ends meet is easily determined, and this is the point of maximum drop, which drop should not exceed 2 per cent in lighting circuits. This condition determines the size of the distributing main.

K. G. Dunn: I think it would be interesting if Mr. Lisberger would tell us how he located grounds in the system—if you have new stunts on that for quickly locating them?

S. J. Lisberger: If you have a real good short you don't have much trouble. Usually we use in San Francisco a little device that we call a jigger.

After having located the leg of the feeder that is grounded (which can usually be done by means of a small transformer, one terminal of the primary of which is connected to one of the three buses or one of the three legs; the other terminal being grounded) the lamp is connected in series with the secondary The lamp will light when the transformer terminal is placed upon the leg that is grounded.

We next impose a high frequency current on the grounded leg by connecting one terminal of a small motor generator to same, and the other terminal to the ground; and then by means of a telephone receiver, which is carried along and held over the manhole, from the sound induced in this receiver by this high frequency current we can locate the fault. The receiver will hum quite distinctly if same is held over the manhole between the point of the fault and where this high frequency current is impressed, (which is usually at the station) but when beyond the fault, the receiver will not hum.

H. Y. Hall Jr.: Have you looked into the scheme they use at the Seventy-fourth Street Power Station of the Interborough Rapid Transit Company, New York? They have a 100 light Brush arc machine which has a reverser, which reverses the direction of the current in the line about once every four seconds. The machine is used as follows: In cases of a grounded phase, they connect one side of the arc light machine to the lead sheath and the other side to the grounded conductor. In cases of short circuited phases, the terminals of the bad phase are connected to the arc light machine terminals. Whenever a ground or a short circuit has too high resistance to allow the arc machine to build up, a high tension testing transformer is used to break down the cable. The current flowing, goes out the conductor and back through the lead sheathing, and vice versa, reversing every four seconds. The cable men go out to the different man holes, and place a compass on top of the cable, and every time the current reverses, of course, the compass swings around 180 degrees. When they get beyond the ground or the short circuit, the compass will not reverse.

S. J. Lisberger: That is very much on the principle of this little jigger, except that you have to open the manhole.

A. H. Babcock: I haven't had much to do with underground systems except in Salt Lake City, where the city authorities required a certain proportion of the work to be put underground in a given time. I believe we ran over our time about 100 per cent or more. The city blocks there are very large. If I remember correctly they are between 600 and 700 feet square. The problem there of course is a little different from what it is in San Francisco. So much waste space exists in the center of the block that it was easy for us to get sub-station locations in the block center; to come underground there at 4000 volt circuit; to place the transformers on the surface of the ground instead of in the manholes (which is a distinct advantage) and run out from this little station at ordinary working potential, 3-wire single phase, also with the 3-phase motor circuit. In this underground work he followed practically the same construction that Mr. Lisberger has outlined here.

From time to time I have noticed in the technical press notices of a different form of construction, in that a fibre conduit was used surrounded by concrete, the tubes being six or eight feet long, with screw connections. I would like to ask if anybody has had any experience with such system for underground work for lighting service, and what the practical results are in regard to breakdowns?

H. W. Mozier: I believe that this paper tube that Mr. Lisberger spoke about is the fibre tube.

S. J. Lisberger: There are two kinds: the paper was the first development, and the fibre the next. I don't remember whether that one that went up was paper or fibre, but I know what happened; the street went up with it. The thing was that the duct clogged so we could not shove anything through it. We could only get our fish wire in so far, as far as where the burn-out was. We located where it was by measuring and digging it up.

A. H. Babcock: What was the condition of the duct?

S. J. Lisberger: It was fused and clogged.

G. C. Holberton: We laid some in Oakland on Second street, tried it as a matter of experiment. Based on the price they would charge per lineal foot we thought it would be very much cheaper, due to the fact that it was light, easy to transport, and in laying it a man laid a great many more duct feet at one time than with the clay duct. In practice, after having laid about two blocks we found that the cost was just about as great as it was with the clay duct, and did not offer any material advantage. I think that the ideal system, as far as high tension cables go, is to lay single ducts with all joints staggered. That for high voltages this is ideal. I have never known a cable in giving way to melt such a duct.

S. G. McMeen: Do you use any split single duct, where you want to pick up and replace a damaged section of a cable?

S. J. Lisberger: I don't recall that we have used any of that.

S. G. McMeen: Mr. Holberton states that a single duct offers that advantage, that you take out the single duct because it is split lengthwise.

G. C. Holberton: We try and keep our outside ducts free, and very often use the outside ducts without building a service hole, by breaking into them as you describe. In which case we open up the street and expose one of the outside ducts, and pull the cable into the consumer's premises directly from the duct.

S. J. Lisberger: I found a peculiar condition in Newark. split form in power house work after the cable is up to get protection against short circuits. It gives you one solid wall. The Chicago-Edison used a good deal in their sub-station work.

S. G. McMeen: They had a number of cases where they had to have some such solution, and they continued to use it extensively.

H. N. Mozier: In New Jersey and surrounding towns one company with 13,200 at their primaries, in recent years have put in almost all fibre ducts. They formerly put in paper duct. The telephone office there found the use of the fibre duct costly. They abandoned it to use clay entirely, because of the difficulty in pulling out the cables.

S. J. Lisbeerger: I found a peculiar condition in Newark. Practically all of their secondary cables, that is, cables of 200 volts, were rubber insulated without lead in their underground system.

A. H. Babcock: I always understood one of the strong points of the Orangeburg fibre duct to be that when there was a burn-out it would not be damaged. I am surprised to hear Mr. Lisberger state that there was trouble where he had to dig the street out.

The Chairman: The public service corporation of New Jersey is using fibre conduit entirely in their lines across what is known as the Hackensack meadows, a very marshy and wet section about eight miles wide. The New York & New Jersey Telephone Co. is also using fibre conduit for all lateral lines.

Fibre conduit is used exclusively by the Brooklyn Edison Co. for their underground system. I know that the experience of the Brooklyn Edison Co. is that they haven't had as much trouble from burn-outs, with fibre as others have with tile. Perhaps Mr. Worthington can help us out on this?

H. L. Worthington: I would like to state we had a little experience a few nights ago at the junction of Post and Kearny streets. The Pacific Telephone Company had laid a paper duct up and down Post, and whoever had charge of the laying of that paper duct forgot to put concrete around it, especially between the paper duct and the Edison tubes. Our Edison tube ran north and south on Kearny, and the paper duct east and west on Post. There was concrete all around the paper duct except between the iron covering of the Edison tube and the paper duct itself. A short circuit came in on the Edison tube, and the copper in the paper tube started burning. The consequence was that three of the telephone company's manholes exploded, and the police department and the fire department were called out, and for a while there was all the trouble you wanted. The only damage we had was the loss of about three feet of the Edison tube. I don't know what the extent of the damage to the telephone company was, but I know they had a big crew of men working for 48 hours or more. It happened at a very bad time because I understand that the main cable of the Pacific Telephone Company running to the Palace Hotel was the one that burned up. Colonel Kirkpatrick was afraid he would have no telephone service on the night of the banquet, but they worked overtime and got it working.

Speaking of ideal manholes for electric light and power service, I wish to state that we have some manholes in the city at the present time that I consider ideal. We have manholes here that are so equipped at the present time that it is no trouble at all to operate hot at 2300 volts. With the wooden fuse tongs and other appliances that we have it would almost be safe for a layman to go down and operate the boxes, even a man not familiar with the business.

Speaking of underground ordinances and overhead lines removed and one thing and another, I wish to state that a week ago yesterday I received instructions to remove all poles and overhead lines on Fillmore street between Sutter and Fulton, the same to be removed and wiped out of existence by January 1st. In that territory we are, I think, at the present time delivering somewhere between three and four thousand kilowatts. That was quite a problem. It is a territory that covers, from Sutter to Fulton, a business thoroughfare, and when it comes to working on the overhead end of it the linemen are handicapped by the number of people promenading up and down the street, especially the women looking in at the show windows. The problem that we have to face is to supply all these establishments with light and power and at the same time simply wipe your line out of existence. As Mr. Holberton said a few minutes ago, one ordinance passed by the Supervisors here pertaining to Fillmore street reads that the overhead poles and wires must be removed; and I would like to mention that it would be quite an interesting proposition for any member here tonight to go up to Fillmore street and notice the class of work we are doing there. It is a new style of underground work, which requires no ditch in the street. We take our conduit, and run right along the face of the building, and it makes a very nice neat job, (laughter). I may say, as far as the underground part is concerned, as Mr. Lisberger said this evening, the character of the buildings on Fillmore street is such that it would be impossible for any engineer to figure out an underground system in that territory. Most of the buildings are of a temporary character, and if you go ahead and put in an underground system in two or three months you should have to change it. With the conduit system we are putting in there at the present time it is ideal, and I think it would be worth while for any member here tonight to travel out that way and look at it.

Question: How do you cross the intersections between streets?

H. L. Worthington: We are feeding the different blocks from the cross streets. The ordinance does not prohibit us from continuing the pole lines on the cross street, across Fillmore, but we are not allowed to maintain any lines on Fillmore.

G. C. Holberton: I would like to state that there is another form of underground conduit that you have not mentioned at all. I don't know very much about it except what I obtained in the way of literature, but a firm in St. Louis has a patented scheme for constructing underground conduits very much as

you make maccaroni. They have a concrete mixture which they pull along the ditch, and after they pass by you have one of those peculiar underground systems with as many holes as you want. I think there is probably something in it.

A Member: There has been some thousands of feet of that put in in one of the smaller cities near New York. It is worked in quite a simple manner. They used paper tube, and they elevate a tank about 15 feet high on legs in the street, and connect all these paper tubes with the water, just about enough head to keep the concrete from collapsing the tube, and they have a form which they drag along in the trench, and the concrete is poured into this form, and the tubes are carried right through the form, and the water keeps them swelled out to the proper size to form the duct.

They have another variation of this. Instead of using concrete, they use concrete made with an asphaltum plaster mixture; and they have tried some of that to a certain extent, and by using bare copper conductors they have been able to use 220 volts with no conductors at all. How long they will last against water and other things is another matter.

S. G. McMeen: Relative to forms of duct material, a good example of a moulded duct is found in Mexico City, made of concrete in multiples. The length of a section is one meter, and the number of ducts per section as high as 36. The sections are poured in a metal mould in a yard near the work, and are laid with proper alignment directly in the ditch without a special bed or an envelope of any kind.

Where the costs of cement and labor both are low, as is true in many of the southern countries, and where standard duct materials would have to be brought from a distant market, such a method has distinct advantages.

A Member: I would like to ask Mr. Lisberger if the effects of electrolysis on the Edison tube have been very wide-spread, and in what localities found?

S. J. Lisberger: The subject of electrolysis is very broad. It has no different effect than on a gas-pipe, except more localized in certain sections, due to the fact that where junctions come you don't get very good contact from pipe to pipe.

Question: That should help it out?

S. J. Lisberger: In a gas-pipe where it is leaded in you get good contact; therefore not so much electrolysis action on each section.

Question: I would like to ask if any solution has been offered whereby telephone and telegraph, light and power currents can all be put in one conduit system. I believe I have seen something in connection with that. A city had put in its ordinance that the company should provide a certain number of ducts for its private use. We do know that cities have compelled light and other companies to combine and do away with so many poles, and put the high tension lines at the top, and the telephone lines either on cables lower, and thus cut down the number of poles to one quarter of the number that originally existed. I believe Los Angeles has been boasting considerably of late years of that idea, where the poles are common property of the several different companies doing different classes of work; and I would like to know if this problem of using the different conduits has been worked out to make them a sort of common property for those different classes of service?

S. J. Lisberger: Baltimore has such a system. It was built by the city under the chief engineer, Phillips. They built a system and charged each company 5 cents per duct feet per year as rental. Boston I think in one or two places has such a system of that kind. New York has a conduit system but only in part—the Consolidated and Empire subways. They are now endeavoring to keep the high tension entirely separate. The disadvantage of the system is that if you have trouble you usually give it to your neighbor.

In going in one of the manholes in Baltimore in the crowded business section, which would compare with Third and Mission, with an 84 duct line, we went down something like 4 feet below the street before we got to the top of the manhole, and the manhole was about 12 feet deep. Of these 84 duct lines there were about 63 full. I had a good look and went up. I had no desire to stay in there. There were railroad load lines, 13,000 volt cable, ground return wires, telephone and telegraph. It was certainly a most dangerous looking construction.

G. C. Holberton: The usual practice here in the matter of the city obtaining the use of a duct line, is to work with the telephone companies. In the first place the general use of the duct line by the City is, that for their fire alarm and police department calls, which is more or less the same nature of service as the telephone company, in other words, communication. In the second place, they can do that for the reason that the telephone company operates under a franchise, and when the city grants the franchise it can put in that stipulation and the company can take it or leave it alone. In California the power companies do not operate under a franchise and they could not very well be put in under the same conditions. The right to lay the ducts and distribute is not a right granted by the city, it is given by the State constitution.

S. G. McMeen: There is no doubt that the practice here would be the usual practice, and which is dictated by common sense; that the high tension circuits could not properly go into conduits with the communication system. I think you will find, if an expression of opinion were taken generally in this meeting, it would be to separate the systems primarily on the basis of their use, the small wire, communication circuits on the one hand, and the large wire, heavy-current-carrying circuits on the other. If you ever went further than that, and combined large current devices and small current devices in one conduit line, every practical, thoughtful person would say that the two conduit lines must have separate manhole systems. If the worst came to the worst, and all the conduit lines in a given street were tied in one, unanimity of opinion would immediately be found that the power company have a separate set of manholes of its own. Such systems have been combined.

DEDICATION OF THURSTON MEMORIAL TABLET.

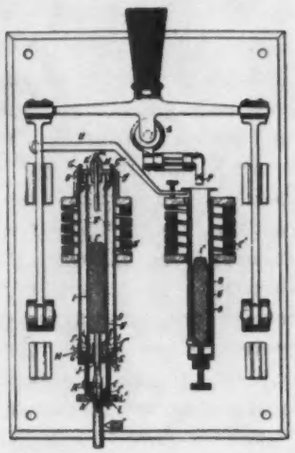
The New York monthly meeting of the American Society of Mechanical Engineers for February was devoted to the dedication of a bronze memorial tablet to Dr. Robert H. Thurston, the first president of the society. Addresses were given upon Dr. Thurston as a man, and his life work. These addresses touched upon his experience as an engineer of the navy during the Civil War; his work as an educator at Stevens Institute of Technology and at Cornell University; his achievements as engineer and investigator; as an author; and his long relationship with The American Society of Mechanical Engineers. Among those who participated were Prof. John E. Sweet, closely associated with Dr. Thurston in the organization of this society; Col. E. A. Stevens, the prominent represetnative of the Stevens family, founders of Stevens Institute; President J. G. Schurman of Cornell University; Prof. Albert W. Smith, Dr. Thurston's successor as director of Sibley College; and Mr. William Kent, consulting engineer. Dr. Alex. C. Humphreys, president of Stevens Institute, was the chairman.

INDUSTRIAL ENGINEERING—THE ENGINEERING DIGEST

The Engineering Digest has been consolidated with Industrial Engineering of Pittsburg and will hereafter be published as Industrial Engineering and The Engineering Digest by Robert Thurston Kent, formerly managing editor of Industrial Engineering. The publication offices are at 220 Broadway, New York City. In assuming charge Mr. Kent announces that at present only that it is his intention to continue the special features for which The Engineering Digest has been noted, including the valuable Index to current technical literature and the condensation of important articles and papers on engineering subjects. To these will be added special features along lines of industrial engineering, and original articles on engineering subjects, distinct from the civil and electrical engineering matters which are so well taken care of by other periodicals.

PATENTS

947,981. Electrical Time-Limit Switch. Philip K. Stern, New York, N. Y., assignor to General Electric Company.. The combination with an electric circuit, of a freely movable member for opening said circuit, actuating means for said responsive to predetermined current

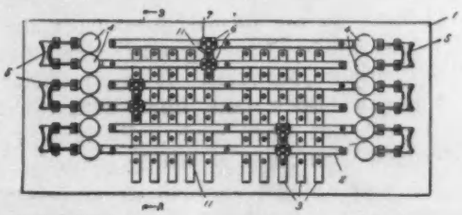


in said circuit and normally so related to said member that said actuating means is unable to move said member, and means responsive to other predetermined current conditions whereby the relative position of said actuating means and said member is varied to enable said actuating means to move the said member.

947,878. Fuseless Rosette. Herbert C. Wirt, Schenectady, N. Y., assignor to General Electric Company. A rosette for supporting knotted branch-wires comprising a single piece of ceramic insulating material provided with a

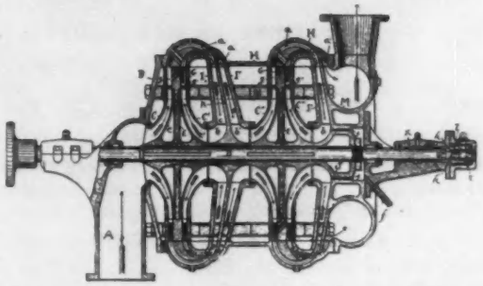
straight transverse aperture of sufficient size to receive said knot, with a central aperture connecting with the transverse aperture, and of a size to receive only the said branch wires, and with means for making contact between wires.

947,956. Metering Panel-Board. John J. Agutter, Seattle, Wash. A switchboard comprising a base, two series of conductors on said base spaced from and crossing one another,



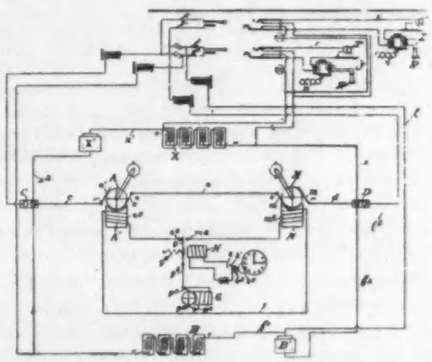
contact members slidably supported on the conductors of one series, other contact members carried by said first named contact member, and means on said other series of conductors for securing said last named contact members thereto.

948,292. Multistage Centrifugal Pump. Arthur Giesler, Dayton, Ohio, assignor to The Platt Iron Works Co., Dayton, Ohio. In a multi-stage centrifugal pump, two impellers ar-



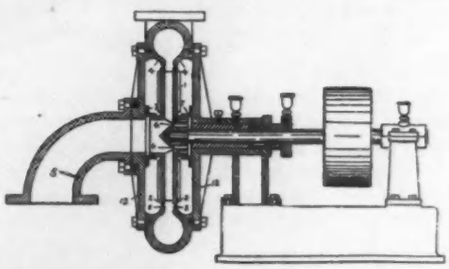
ranged with their inlets facing in opposite directions, passageways adapted to conduct the fluid from one impeller to the other, and means mounted at the intermediate inlet of the last-impeller for balancing the thrust of the pump.

947,781. Apparatus for Alternating the Polarity of Current in Electric Circuits. Garrison Babcock, Rochester, N. Y., assignor to Telechrometer Co., Rochester, N. Y. An apparatus of the character described, comprising two generators



arranged in series and connected so as to be of opposite polarity and having fields, means for alternately exciting said fields, and means associated with two generators for absorbing the varying current of each polarity produced during the operation of one or the other of said generators.

948,228. Centrifugal Pump. Ferdinand W. Krogh, San Francisco, Cal. In a centrifugal pump, an impeller having protection on the discharge edge thereof, said protection consisting of a metal ring detachably secured to said discharge edge of the impeller, in combination with a stationary



casing having a circumferential rib on the inside of the same, and said rib having protection on its edge, said protection consisting of a metal ring detachably secured to the edge of the rib for the purpose specified.

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POWER AND GAS

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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Fuel Oil Firing

The essential difference between steam power plant practice in the East and in the West is in the fuel employed. Coal, either anthracite or bituminous, is burned under the majority of the boilers in the East, while on the Pacific Coast crude oil is the most important fuel. In certain lumbering localities, particularly in the Northwest, sawdust is also used as a power source. The cause for this sectional preference is distinctly one of cost. Eastern coal is cheaper than eastern oil; western oil is cheaper than western coal. Cheap fuel is indispensable to industrial progress and it is only since the development of its abundant oil and water resources that the Pacific Coast has done much manufacturing.

Additive to its western cheapness and compensative for its eastern expensiveness there are certain advantages that attend the use of fuel oil. It burns without a residuum. There are consequently no clinkers and no ashes to obstruct the grate, interfere with the air supply and cause incomplete combustion. It is the most concentrated of fuels, occupying a minimum of space and giving a maximum of heat, weight for weight. It takes less time to get up steam with oil than with coal. This practically eliminates the necessity for banked fires or reserve in steam drums. Oil usually gives a larger overload capacity and is thus pre-eminently invaluable as an emergency fuel. Auxiliary oil firing is therefore frequently employed in plants burning lampblack or sawdust.

Oil is practically self-stoking and greatly lessens the work of the fireman, one man oftimes replacing several in a plant containing many boilers. This does not necessarily mean that the fireman's job thus becomes a sinecure, but rather it changes his work from that of a mere coal-passer, a machine, to that of an integral factor in the economic and efficient operation of the power plant.

By properly regulating the pressure and the amount of oil and by correctly adjusting the pressure and quantity of steam or air, the fireman can reduce the volume of oil necessary to generate a given amount of steam. In a single boiler plant, such as a locomotive, the fireman helps the engineer and thereby lessens the possibility of accidents.

To properly utilize the advantages above suggested, hundreds of oil burners have been devised, each better than the other. In general, they are all based upon a means of atomizing the oil and distributing it in the furnace either by compressed air or steam, theoretically the former, practically the latter. Crude oil does not burn readily until it has been subdivided into minute particles. It is possible to drop a lighted match into a tank filled with oil without burning the oil, but when each individual particle is properly mixed with air it is readily ignited. Experience shows that a burner which gives success with one type of boiler is not adapted for another. Proper furnace construction is of paramount importance with the type of burner with which it is equipped, and each class of boiler installation requires the special attention of an expert to give the best results.

PERSONALS.

C. H. Pennoyer, Pacific Coast manager of the National Conduit & Cable Company, is in Los Angeles.

Geo. R. Murphy, sales engineer with Pierson, Roeding & Co. of San Francisco, left for the East this week.

F. L. McGillan, manager of the California Pole & Piling Company, of San Francisco, recently returned from a trip through the Pacific Northwest.

G. J. Henry, Jr., engineer with the Pelton Water Wheel Company, is making a Northwestern trip and will return about the middle of February.

E. E. Gilbert, manager of the turbine sales department of the General Electric Company, of Schenectady, N. Y., has arrived in San Francisco on a visit.

R. J. Cash, electrical engineer with the General Electric Company's Portland office, has gone North, after spending two weeks in San Francisco on business.

G. I. Kinney, San Francisco, manager of the Fort Wayne Electric Works, has just returned from a Pacific Northwest business trip of several weeks' duration.

Julian Thornley, a well-known Eastern engineer, is on the Coast and is looking over the Great Western Power Company's hydro-electric plant at Big Bend.

Edward L. Brayton, president and general manager of the Pelton Water Wheel Company, has returned to San Francisco from his annual visit to the New York office.

Wynn Meredith, of Sanderson & Porter's San Francisco office, has gone to New York, after spending several weeks in Victoria, B. C., and vicinity in connection with electric power plant extensions.

W. H. Leffingwell, engineer of the Mono Power Company, has returned to his office at Bishop, Cal., after spending a week in San Francisco, on business connected with the completion of a transmission plant on the Owens River.

Leon M. Hall, consulting engineer for the Comstock mines, has returned from a trip to Virginia City, Nev. Mr. Hall has removed his San Francisco office to room 1120 Kohl building, with the new firm of Hall, Demarest & Co.

Charles Blizard, third vice president and general sales manager of the Electric Storage Battery Company of Philadelphia, who spent some days at the San Francisco agency, besides visiting Los Angeles and Seattle, returned to the East during the past week.

D. R. Bullen, manager of the supply department of the General Electric Company, and C. W. Stone, assistant engineer of the lighting department, have arrived from Schenectady and will attend the annual meeting of the company's agents at the San Francisco office.

C. L. Cory, electrical engineer, has turned in to Chairman Loughrey of the Telephone Committee of the Board of Supervisors of San Francisco his third annual report on telephone charges. This is based on the operations of the Pacific States Telephone Company's plant.

E. P. Kennedy, assistant superintendent of the Alaska Treadwell Mining Company, spent the past two weeks in San Francisco, closing contracts for the equipment of a new hydro-electric plant which will utilize the water of Sheep Creek at a power site a few miles from the mines.

Theodore B. Comstock has been retained as consulting engineer to the Public Utilities Commission of Los Angeles, Cal. Mr. Comstock was formerly president of the University of Arizona and at one time was connected with the department of geology at Cornell University. For some time he has acted in the West in an independent consulting capacity.

R. B. Daggett has resigned as Pacific Coast manager for the Electric Storage Battery Company and has formed a new company, known as R. B. Daggett & Co., to enter the electric vehicle field. The new company will handle the Baker electric pleasure vehicles, Walker electric trucks, Elco motor boats and launches, Reed electric head-lights, and other specialties. It is operating electric garages in San Francisco, Mayfield, San Jose and Oakland, California.

MAP OF TRANSMISSION LINES.

In connection with the map of the transmission systems of California and Nevada, which was published as a supplement to the Journal of Electricity, Power and Gas, of February 5, 1910, it should have been stated that it represented only the hydro-electric power plants. In addition there are many steam plants supplying power over long-distance lines such as the Ventura County Power Company of Oxnard, California, which is operating about sixty miles of a 33,000-volt 50-cycle system with seven sub-stations throughout the county. In this respect the map is incomplete, which defect will be remedied in future editions.

TRADE NOTES.

O. E. Slater, of the San Francisco office of Smith, Emery & Co., inspecting and testing engineers, will go to Los Angeles to take charge of the new office, which is to be established at 245 South Los Angeles Street under the style of Smith-Emery Company. He will have four assistants at the start. The firm are converting the two-story brick building which they have purchased at the above location into a first-class physical and chemical testing laboratory. It is laid out on the lines of their local plant, but a new feature with this firm will be a complete equipment for electrical testing work of almost every kind.

Manager Grant of the Four Mining Company was in San Francisco last week closing contracts for an 800 h. p. hydro-electric plant on Mt. Whitney Creek near Keeler, Cal. It is understood that General Electric generators direct connected to impulse water wheels, operating under an effective head of 750 feet, will be installed. Current will be transmitted at 20,000 volts to Keeler, where the company's smelter and soda works are situated. In order to operate these and the electric hoists and air compressors at the mine, about 20 miles of pole line will be required. Sidney Sprout is the consulting electrical engineer.

The Pelton Water Wheel Company secured the contracts for the two 1900 h. p. maximum-efficiency impulse wheels, to be direct connected to two 1,000 k. v. a. generators, which the Alaska Company will shortly install on Sheep Creek for an additional supply of power to their mills. The distance of transmission will be about five miles. Two direct rope drive Pelton units have also been purchased to supply power to the same Company's "Mexican" and "Ready Bullion" mills. The combined crushing capacity of all of the mills is 4800 tons of ore per day. Special attention will be paid to water wheel efficiency at fractional loads in the above equipment.

The General Electric Company reports the closing of electrical contracts for a hydro-electric transmission plant with the Alaska Treadwell Gold Mining Company for their Sheep Creek power development in Alaska. The electric equipment comprises: Two A. T. B. 18, 1000-kw., 400 r. p. m. 2300-volt water wheel driven generators; two 2-unit, 3-bearing motor generator exciter sets, each consisting of one I. 6, 50 h. p. 1200 r. p. m. Form K., 2200-volt, induction motors, direct connected to one D. L. C. 4, 35 kw. 125-volt, compound wound generator; six W. C. 60, 667 kw. 2300-volt, primary, 22,000-volt secondary transformers are also included with a 5-panel switchboard and a Tirrell regulator.

NEWS OF THE STATIONARY ENGINEERS

PREAMBLE.—This Association shall at no time be used for the furtherance of strikes, or for the purpose of interfering in any way between its members and their employers in regard to wages; recognizing the identity of interests between employer and employe, and not countenancing any project or enterprise that will interfere with perfect harmony between them.

Neither shall it be used for political or religious purposes. Its meetings shall be devoted to the business of the Association, and at all times preference shall be given to the education of engineers, and to securing the enactment of engineers' license laws in order to prevent the destruction of life and property in the generation and transmission of steam as a motive power.

N. A. S. E. CONVENTION.

The seventh annual convention of the California State Association, National Association of Stationary Engineers, will be held in Los Angeles, May 23-28, 1910, on the fourth floor of the new Hamburger building, Eighth and Broadway. The committee has issued a diagram of floor space which contains complete information for intending exhibitors at the engineering and mechanical exhibition to be held in connection with the convention.

OREGON NO. 1.

The open meeting of Portland No. 1, N. A. S. E., on Feb. 2, 1910, was addressed by Mr. H. E. Harris of the Harris Ice Machine Works on the subject of refrigeration. Mr. Harris received the warmest approval for his efforts and the discussions following his address showed the interest taken by the engineers. Before the close of the meeting the chairman of the educational committee, C. E. Boswell, announced that at the open meeting on the evening of February 16th next, an address would be delivered on "Electric Elevators" by Chief Engineer C. H. McGirr of the Wells Fargo Building, and at the meeting two weeks later Manager Herbert E. Judge of the Valvoline Oil Company, an associate member of the association, would deliver an address on "Machine Oils."

PRACTICAL MECHANICS.

PAPER NO. 7.

Axes of rotation intersecting without meeting. In some cases of transmission between axes not parallel and not meeting it is practicable to use an intermediate piece or link as shown in Fig. 6. Here the crank pins are parallel to their respective axes and, since the angle of intersection of the axes is the same for all parts

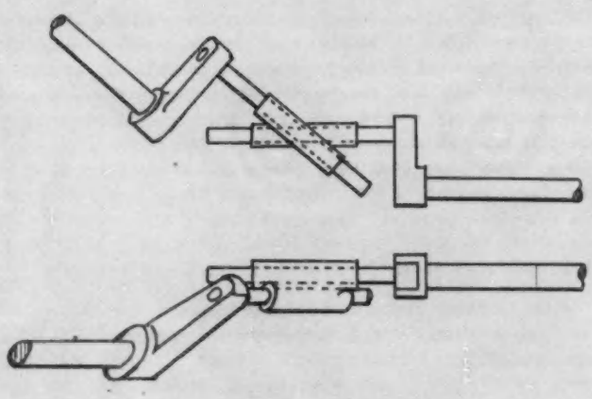


Fig. 6.

of the revolution, the pins must make a constant angle. The intermediate piece or block then is provided with long holes making this fixed angle. There is, of course, longitudinal sliding of the pieces in the holes, but this is often permissible and really facilitates lubrication. This mechanism often greatly simplifies transmission between two axes not meeting, but when an additional link is employed, as sometimes must be done, it becomes too complicated for efficient application.

Here, as also in the next succeeding device—the Hook's universal joint—the angular velocity relations are complicated, and there are, in some instances, dead center points which must be overcome.

Hook's universal joint is a familiar form of connection between rotating axes. The coupling consists of a forked or clevis-shaped attachment on the end of each shaft. The four bearings of these two forks fit the ends of an intermediate cross-shaped piece. Or this piece may be a disk with pins at each 90° on its circumference, or even a sphere is sometimes used. Whatever its form, the axes of its two pairs of bearings intersect in a point, and the forked ends of the shafts must be so adjusted that this point of intersection is at the point of intersection of the main shafts (extended). See Fig. 7.

The two sets of bearings *AB* and *CD* revolve in circles whose planes are perpendicular to their respective shafts. A little reflection will show that the relative angular velocities of the two shafts varies throughout each revolution. Suppose, for example, that shaft *E* were turning with a constant angular velocity. Then *CD* will be turning in a plane perpendicular to the paper and to the shaft *E*, i. e., the points *C* and *D* will have a certain, constant peripheral velocity. As rotation takes place it is evident

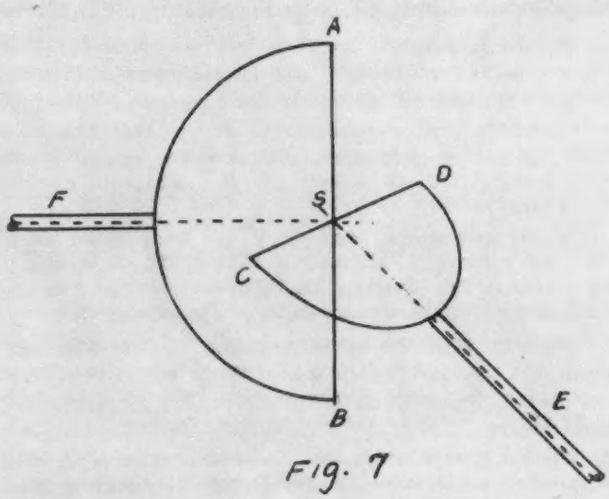


Fig. 7

that the radial distance of *C* or *D* from the axis of *F* is variable, being a maximum when *CD* is perpendicular to *F* and a minimum when *AB* is perpendicular to *E*. Now, since peripheral velocity is the product of angular velocity and radius, it follows that the angular velocity *F* must vary with the radius of the driving points *C* and *D*. There will be two points of maximum and two of minimum velocity during each revolution, the amount of variation between them depending upon the angle of intersection between the shafts.

In practice the shafts to be connected by a universal joint should not make with each other an angle greater than 30°, as otherwise the radial variation above mentioned becomes so great that excessive strains are made upon the pins and bearings. The complete mathematical solution of this angular variation forms an interesting problem in trigonometry and the differential calculus.

In order to transmit uniform angular velocity the double universal joint may be used. This is simply the addition of a second joint at the other end of shaft *E*, for instance, with the forked end set parallel to the existing one and the final driven axis or shaft making the same angle with *E* as the angle between *E* and *F*. It will be seen, therefore, that the double universal joint will permit of transmission between either parallel axes or (by making the angles 45°) perpendicular axes. By this means it will be seen that the angular variation given by the first joint are neutralized by the second one.

APPROVED ELECTRICAL DEVICES

ATTACHMENT PLUGS, FUSELESS

"G. E." 3 A., 250 V. Porcelain base types, Cat. Nos. 28840 (swiveling cap), 34153 (brass cap) and 50996. Composition, Cat. No. 48661 (weatherproof). Approved Jan. 5, 1910. Manufactured by

General Electric Co., Schenectady, N. Y.

CONDUIT BOXES

"Pipe Taplets." Cast Iron Outlet Boxes with threaded openings for standard sizes of rigid conduit. Cat. Nos. 4410-4414 incl., and 4170. For use with special porcelain covers or with suitable approved rosettes or receptacles. Approved for exposed work only; Jan. 5, 1910. Manufactured by

H. T. Paiste Company, 32d and Arch Sts., Philadelphia, Pa.

FIXTURES.

"Benjamin" Tungsten Arcs, Indoor and Weatherproof Forms. Cat. Nos. T-14, T-45, T-44-k, T-45-k, T-46-k, T-62, T-63, T-64, T-74, T-75, T-83, T-84, T-85, T-714, and T-715. Approved Jan. 13, 1910. Manufactured by

Benjamin Electric Mfg. Co., 507 W. Jackson Blvd., Chicago, Ill.

HEATERS, Electric.

Vulcan "Electrocurl" for use on 110-125 or 220-250 circuits. A curling iron with a removable heating element inside the case. Heating element consists of resistance wire wound on a lavite tube. Approved Jan. 13, 1910. Manufactured by

Vulcan Electric Heating Co., 69 W. Jackson Blvd., Chicago, Ill.

INSULATING PAINTS.

"S P C" Asphalt Varnish. For use as a protective coating especially for surfaces directly exposed to the weather. Approved Jan. 13, 1910. Manufactured by

Standard Paint Co., 100 William St., New York, N. Y.

MISCELLANEOUS.

Bell signaling system consisting of single stroke bells of special pattern connected to 110 or 220 volt lighting circuits. The bells may be connected in one or more series sets, these sets being connected in multiple with the supply circuit and in series with a special oil immersed contactor relay. The signals are transmitted by the relay, the magnets of which are energized by battery current. Approved resistances suitably mounted are used to limit the current flow through the relay to 10 A. Approved for use when the wiring of the gongs and relay is installed according to Class C of the National Electrical Code; Jan. 12, 1910. Manufactured by

Autocall Co., Shelby, Ohio.

"P. M." Meter Connection Blocks, not over 30 A., 125 V. Special porcelain cutout bases, with metal enclosing case; designed for preventing theft of current and to facilitate the inspection and test of service meters. Type A, with single piece enclosing case. Type E, with two piece enclosing case and with double pole indicating snap switch for use as service entrance switch. The enclosing cases of these devices are not considered as the equivalent of a cabinet for enclosing service entrance switches, when such cabinets are required. Approved Jan. 13, 1910. Manufactured by

Price-McKinlock Co., 156-160 Pearl St., Boston, Mass.

RECEPTACLES, STANDARD.

Wall Sockets, Brass Shell. Key, Cat. Nos. 140 and 142. Keyless, Cat. Nos. 141 and 143. Sign Receptacles, Cat. Nos. 212, 260, 265, 267, 268, 272, and "Russell" 280. Conduit Box Type, Cat. Nos. 210 and "Russell" 280. Cleat Type, Cat. No. 226. Approved Jan. 13, 1910. Manufactured by

E. H. Freeman Electric Co., Trenton, N. J.

RECEPTACLES, WEATHERPROOF.

"Bryant 3 A., 250 V. Cat. Nos. 9407, 9408, 9411, 30000, 44912, 59107, 59275 and Street Hood Sockets, Cat. Nos. 25706 and 25707. Also Cat. Nos. 9407, 30000 and 44912, for use with 110 or 220 volt lamps in series on 600 volt circuits. Approved Jan. 4, 1910. Manufactured by

The Bryant Electric Co., Bridgeport, Conn.

SOCKETS, STANDARD.

"P. & S." Brass Shell Sockets. Key, "Snap Cap" Cat. Nos. 440, 442 and 444, "Bayonet," Cat. Nos. 61059, 61060, 61063, 61065, 61157 (157), 61357 (357), 61457 (457), and 61557 (557). "Protectus" Cat. Nos. 100421, 100423, 100425, 100427-100429 incl. "Passmour," Cat. Nos. 100412, 100414, 100416, 100418-100420 incl. Keyless "Snap Cap" Cat. Nos. 441, 443 and 455. "Bayonet," Cat. Nos. 60157 (0157), 60357 (0357), 60457 (0457) and 60557 (0557). "Protectus" Cat. Nos. 100422, 100424 and 100426. "Passmour" Cat. Nos. 100413, 100415 and 100417. Also the above type with shade holders attached. Approved Dec. 31, 1909. Manufactured by

Pass & Seymour, Inc., Solvay, N. Y.

"Paiste" Brass Shell Sockets. Key, 50 C. P. 250 V. Cat. Nos 9386, 18386, 43389, 49386, 50760, 99386, 59480, 59481, 59484 and 59486, "Security Snap" 44147, 44148, 44814, Keyless, 3 A. 250 V. Cat. Nos. 9392, 19392, 43390, 49392, 50768, 99392, 59482, 59483, 59487, 59485, "Security Snap" 44149, 44150, 44815. Pull 50 C. P. 250 V. Cat. Nos. 61120 and 61121. Also above types with shadeholders attached. Approved Jan. 18, 1910. Manufactured by

H. T. Paiste Co., 32d and Arch Sts., Philadelphia, Pa.

SOCKETS, WATERPROOF.

"Bryant 3 A. 250 V." Porcelain shell; bracket style, Cat. Nos. 9448 and 9496; pendant, Cat. Nos. 9366, 50997 and 59107. Composition shell; bracket style, Cat. Nos. 43311-43314 incl., pendant, Cat. Nos. 42686, 43310 and 60666. Hard Rubber Shell; pendant, Cat. Nos. 42690 and 50788. Also Cat. Nos. 9366, 42686, 42690, 43310, 43312, 43313, 43314, 50788, 50997 and 60666, for use with 110 or 220 volt lamps in series on 600 volt circuits. Approved Jan. 4, 1910. Manufactured by

The Bryant Electric Co., Bridgeport, Conn.

SWITCHES, AUTOMATIC,

Automatic Time Switches. Type No. 20, 20 A. 250 V. Type No. 30, 30 A. 250 V. This device consists of an approved double pole snap switch connected directly to a clock mechanism. A sheet metal case is provided which encloses the clock and switch mechanism. Approved Jan. 13, 1910. Manufactured by

Reliance Automatic Lighting Co., Warren, Ohio.

SWITCHES, FIXTURE.

Fixture Arm Switch, single pole ½ A. 125 V., Cat. No. 3200. Approved for fixture arms only (not canopies) for control of one 16 c. p. 110 v. lamp, and when wired with solid (not stranded) wires; Dec. 28, 1909. Manufactured by

Pass & Seymour, Inc., Solvay, N. Y.

SWITCHES, PENDANT SNAP.

"P. & S." pendant switches, 3 A. 250 V., 6 A. 125 V. Approved Dec. 28, 1909. Manufactured by

Pass & Seymour Inc., Solvay, N. Y.

WIRES, RUBBER COVERED.

Tag on coil to read, "Nat'l Elec. Code Standard." Marking: One yellow and one green thread twisted together running parallel with wire between rubber insulation and braid; black core. Approved Dec. 22, 1909. Manufactured by

Rome Wire Company, Rome, N. Y.

INDUSTRIAL

AUTOMATIC CONTROL OF MOTOR DRIVEN PUMPS.

In this age of electricity where power and lighting lines span the country in every direction, much of the drudgery of the home life is fast disappearing and the electric motor is becoming an indispensable part of the household equipment. This little device has robbed the sewing machine of its terrors and transformed tedious, laborious, back-aching toil into work that it is a pleasure to perform. It has usurped the

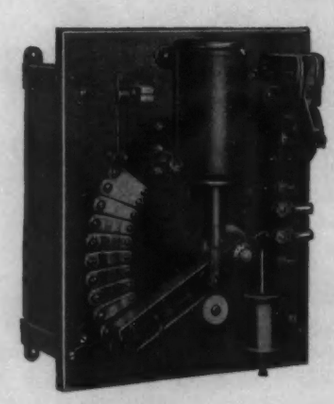


Fig. 1. General Electric Self-Starting Controller.

place of the laundry maid and performs all the laborious work of washday. In many other ways it is eliminating toil and contributing to the pleasures of life.

One of its most interesting applications is to the performance of operations which are of so rare occurrence as

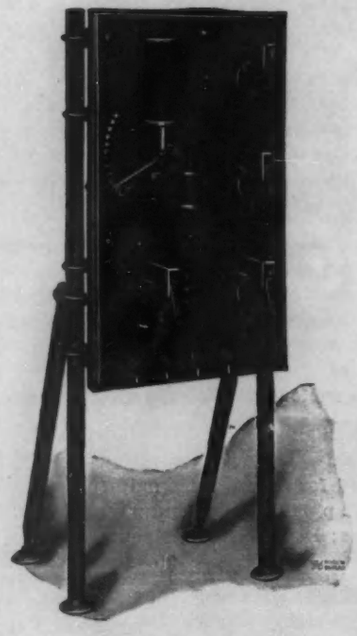


Fig. 2. General Electric Self-Starting Controller for large D. C. Motors.

to make the presence of an attendant an expensive luxury. For such service electricity is an ideal source of power, as it admits of automatic control, is always ready for instant use, and costs nothing except when it is being used. There is no delay waiting to get up steam and its use is not attended with odor, noise, or steam. The motor and controlling apparatus occupy very little space and may be installed on the wall or ceiling where it will be out of the way. Such a device, becomes a servant that needs no watching and never forgets.

An excellent example of the utility of the electric motor equipped with automatic control is its application to the operation of pumps required to maintain a certain water level in a tank. If the water level falls below a certain predetermined value the controlling device automatically starts the motor and the pump continues to operate until the water level is raised to a predetermined value when it ceases to operate.

Figs. 1 and 2 illustrate a device manufactured by the General Electric Company, Schenectady, N. Y., for the service described above, while Fig. 3 shows the manner of its operation. The length of the chain attached to the ball of the float switch is so adjusted that when the water level falls below a certain point, the arm of the float switch is raised sufficiently to close the motor circuit and start the pump which continues to operate until the ball rises and allows

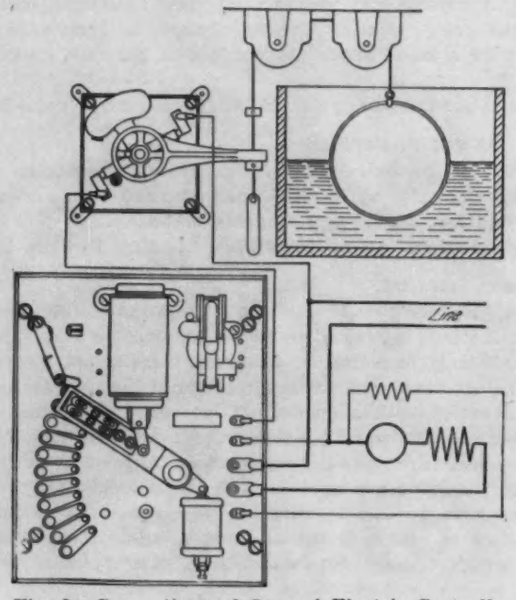


Fig. 3. Connections of General Electric Controller With Float Switch.

the weight to carry the arm of the float switch down far enough to open this switch and disconnect the motor from the line. From Fig. 3 it is easily seen that the length of the chain and the position of the button on it may be adjusted so as to make the water level at which the motor starts and stops anything desired.

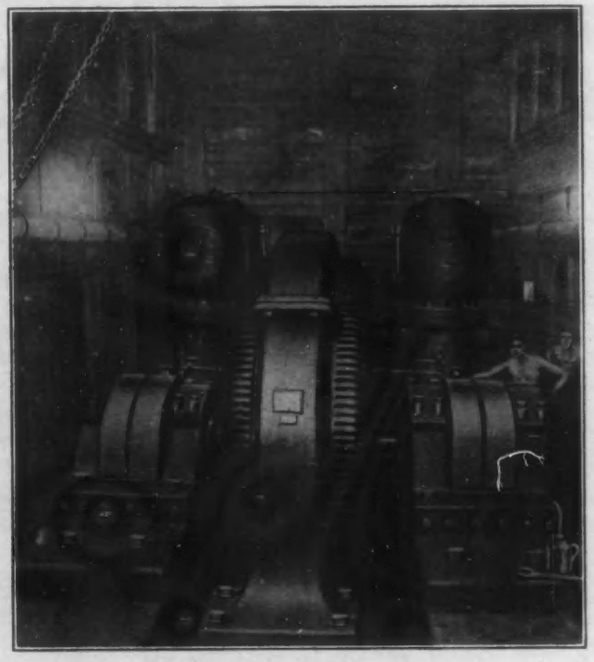
Except in smaller sizes the motor circuit is opened by an auxiliary switch provided with a strong magnetic blowout device which prevents an arc forming when the motor is disconnected from the line and eliminates any fire hazard that might result from a poorly designed piece of apparatus.

The same device will operate to maintain any desired fluid or air pressure if supplied with a pressure governor instead of a float switch. The General Electric Company have such a controlling device for every type of motor.

A LARGE ELECTRIC MINE PUMPING INSTALLATION FOR HANDLING HOT WATER.

In reopening the Ward shaft at Virginia City, Nev., a considerable flow of hot water was encountered, which for a time baffled the efforts of the workmen. The great depth of this shaft, 3480 feet, and the high temperature of the water, 175 degrees, made the work of pumping out the impounded quantity very difficult, but a temporary electric pumping outfit was finally successfully put into commission, and has since been supplanted by a permanent installation which easily handles the present continuous hot flow.

For emptying the mines, in the first place, a temporary motor-driven pump equipment was installed, by which compressed air driven sinker pumps at the bottom of the shaft lifted the water to a centrifugal pump on the 2330 ft. level. This in turn delivered to a vertical triplex pump on the 2100 ft. level. The sinker pumps were supplied with compressed air from two 100 h. p. Ingersoll-Sergeant compound air compressors driven by 100 h. p. Westinghouse motors located on the surface. The three-stage Byron Jackson centrifugal pump on the intermediate level was belted to a 50 h. p. Westinghouse induction motor, while a 100 h. p. type "C" Westinghouse induction motor drove the 6¾ x 8 in. Knowles vertical triplex pump at the uppermost pumping level.



Electric Pumps in the Ward Shaft.

This apparatus has since been replaced by the installation of the permanent pumping plant located in a pumping station 80 ft. long, 24 ft. wide and 20 ft. high, connected with the shaft 3100 ft. below the surface. The permanent pumping equipment consists of a special slow speed, 800 h. p. Westinghouse type "HF" induction motor direct connected to a Knowles express type, duplex, double-acting pump, operated at 195 r. p. m.

The valves are of the automatic poppett type arranged in nests of 13 each, presenting a valve area of 104 square inches, which makes necessary very slight movement of the valves, and is conducive to a high speed and a minimum of wear. The valves and other visible parts are of bronze, and the pump has a capacity of delivering 1600 gallons per minute against a total head of 1550 ft.

The plant is equipped with a three-stage electrically driven air compressor for charging the air receivers, besides a vacuum pump and an automatic oiling system. For convenience of erection and repair, the pump station will be fitted with a 15-ton traveling crane; in fact, it is intended to include in this plant everything that will insure reliability and ease of operation.

The over-all dimensions of each pump are 27 ft. 3¾ ins. in length, 17 feet in width, and 14 ft. 2 ins. in height. The motor is 13 ft. in diameter, and the steel crank shaft, forged from one piece, is 13¾ ins. in diameter and 14 ft 4½ ins. long. The total cost complete for operation was about $125,000. These pumps are supplied by either one of the two centrifugals located in the sump at the bottom of the shaft, and operated by special 75 h. p. Westinghouse motors on a vertical shaft.

The water is discharged through a 16-inch steel column with welded steel flanges. The thickness of this pipe varies from ¼-in. at the tunnel level to 9/16 in. at the bottom. The column is supported by means of heavy weight iron clamps six inches in length, which in turn rest upon the wall and end plates. To resist the pressure of 675 pounds to the square inch, male and female flanges are used and each fitted with a lead-filled copper gasket.

The electric current is taken down the shaft at 2240 volts over a three-conductor, lead-covered, steel-armored cable of 400,000 circular mils capacity. The electrical equipment, from the automatic oil circuit breakers on the surface to the motors themselves, is the best that money can buy; and in operation, with the Westinghouse machine of the Truckee River Electric Company behind it, results have been obtained never before approached for this class of work.

The accompanying illustration of the present permanent pump house, 3100 feet underground, was retouched from an actual flashlight photograph obtained during a recent visit to the mine. The normal temperature of this pump room, 110 degrees F. is attested by the costume of the men, who work their daily shifts of twelve hours under these conditions.

TRADE NOTES.

The Pacific Gas & Electric Company has purchased from the General Electric Company an additional three-bearing motor-generator set for the Temescal sub-station in Oakland. It consists of one M. P. C. 4, 500-kw., 720 r. p. m. 600-volt shunt and compound wound generator direct connenected to an A. T. I. N. 530-kw. 4300-volt synchronous motor.

C. D. Boyd has been appointed Michigan representative of the Kellogg Switchboard & Supply Company, with headquarters at Grand Rapids, Mich. C. Morsman has been transferred from the Michigan territory to the newly created Rocky Mountain district. B. Woodbury has been transferred from Minnesota to the Ohio district, with headquarters at Columbus. E. G. Lawrence has been appointed Minnesota representative. G. A. Joy has been appointed sales engineer, territory west of Chicago, Ill.

The Pierce Phosphate Company is installing a 1150-horsepower Westinghouse gas engine driven alternator set in its new generating station at Pierce, Fla., to serve as an auxiliary to the old power plant containing a number of Deisel oil engines. The new equipment consists of a 1150-horsepower Westinghouse single-crank horizontal gas engine, with cylinder 34 by 42 inches, direct-connected to a 850-kilovolt-ampere Westinghouse alternating current generator, supplying three-phase power at 2300 volts for hydraulic mining work. The engine is furnished with fuel gas from double-zone producers, having a calorific value of 110 B. t. u. per cubic foot. The new addition to the power plant equipment represents an expenditure of about $75,000, and will operate in parallel with the old station, built some six years ago, which contains six 200-horsepower Diesel gas engines driving 150-kilowatt alternators. The installation of the additional equipment is being made under the direction of Mr. A. H. Nickerson, mechanical engineer for the Pierce Phosphate Company, Pebbledale, Fla.

NEWS NOTES

FINANCIAL.

SEATTLE, WASH.—The Council finance committee has agreed to submit the issuance of bonds for $1,030,000 for water extensions to a vote.

MIDLAND, TEX.—Midland is to have a water system costing $50,000. Bonds have been passed upon and approved. They will be placed on sale March 7th. Bids for construction will be open about March 1st.

SEATTLE, WASH.—E. H. Rollins & Son and A. B. Leach & Co., of Chicago, were successful bidders on the $200,000 lighting plant bonds and $500,000 park bonds, offering a premium of $16,450 for 4½ per cent bonds.

LOS ANGELES, CAL.—The town of Lompoc is agitating a scheme of buying the electric light plant and system of which J. T. Worthington is the manager. The Trustees and business men are in favor of calling a bond election to vote bonds for buying the system.

EL CENTRO, CAL.—The City Council has passed an ordinance calling a special election to be held on February 14th for the purpose of submitting to the voters of the city the proposition of incurring a debt of $69,000 for the purpose of acquiring municipal waterworks.

SEATTLE, WASH.—The proposition of issuing $73,000 in water bonds for Kent was carried at a special election, the vote being 197 for and 16 against. The system itself will be bonded to the extent of $50,000 of the whole issue and the town will assume $23,000 of the indebtedness.

LOS ANGELES, CAL.—The City Council has passed an ordinance ratifying and confirming the sale and delivery to Kountze Bros. and A. B. Leach & Co. of New York, of $1,020,000 Water Works bonds of the city, being part of the issue of $23,000,000 authorized at a special election on January 21, 1907.

PLEASANTON, CAL.—A special election will be held in Pleasanton, Cal., on February 8th, 1910, at which time will be submitted the proposition of issuing and selling bonds in the amount of $40,000. Thirty-five thousand dollars of the amount is to construct a sewer system, and $5000 is for completing the water system, the acquisition, construction and completion of additional pipes and one additional reservoir.

LOS ANGELES, CAL.—The City Council passed a resolution providing for the issuing of bonds of the city in the sum of $4,896,000, being part of the issue of $23,000,000 bonds authorized by the voters at a special election held January 12, 1907, for the purpose of acquiring and constructing a certain revenue producing municipal improvement waterworks for supplying the inhabitants of the city with water from the Owens River Valley.

NEWPORT, CAL.—The City Clerk is receiving sealed bids for 40 bonds, each for the sum of $1000, known as Municipal Water Works Bonds, and 25 bonds each of $1000 known as Municipal Light Works Bonds. Each and every one of said bonds bear interest at the rate of 5 per cent per annum, payable semi-annually on August 1st and February 1st of each year after February 10. The certified check must be 2 per cent of the amount bid.

OAKLAND, CAL.—The annual report for 1909 of the receipts and disbursements of the People's Water Company in Oakland gives the net income for the year 1909 as $556,045.91. The detailed report of receipts gives the following figures: Water rents, $939,370.44; tapping, $27,022.45; turning on, $94; land rents, $26, 525.86; total receipts, $993,012.75. The operating expenses for the year detailed were: Supply, $22,456.13; distribution, $96,494.68; repairs, $22,507.53; general expenses, $126,685; administration, $9900; services constructions, $12,674.01; guarantee deposits, $120; total, $290,838.06. The taxes for the year 1909 paid by the company as recorded amounted to $69,257.35. In addition back taxes for the years 1903 and 1904 were collected from the company, making in all $146,128.78 in taxes. This brings the total expenditures to $436,966.84, leaving a balance on the year of $556,045.91. The report does not show what payments were made from this amount on the bonded interest account. The report for Berkeley shows receipts for the year 1909 as follows: Water rentals, $239,733.77; tapping, $8,011.50; land rentals, $7869.02, making a total of $255,654.92. The expenses amounted to a total of $111,371.30. With the payment of taxes amounting to $13,469.11, the net receipts are given as $130,813.88 on a property valuation given as $2,878,888.84.

INCORPORATIONS.

SANTA MONICA, CAL.—The Rand Power & Irrigation Company, with $10,000 capital; directors are: Ehrman and H. H. Grigsby, R. M. Miller, H. J. Engelbrecht.

SACRAMENTO, CAL.—The Sheldon Townsite and Realty Company has been incorporated at Sacramento for the purpose of building a town at Sheldon, on the line of the Central California Traction Company, which will operate an electric line between Sacramento and Stockton. The company will install its own electric lighting power and waterworks. The incorporators are: G. W. Peltier and F. W. Kissel, Sacramento; and J. C. Coffing of Florin.

TRANSMISSION.

EVERETT, WASH.—It is reported that the Sultan Railway & Power Company will install a power plant at the head of Sultan Canyon.

LOS ANGELES, CAL.—The Southern California Edison Company has asked the Board of Supervisors for a franchise for a large number of electric transmission lines in the county.

CITY OF MEXICO, MEX.—An application has been made by Aristides Betancourt for a concession to start a factory for making dynamos, electric machines, motors, transformers and all classes of transmission machinery. The department of fomento has the application under consideration.

LOS ANGELES, CAL.—Sealed bids are being received by the Board of Supervisors for furnishing and erecting power line transformers and a transformer house. The line is to extend from the San Fernando sub-station of the Southern California Edison Company to the transformer house to be erected near the Pacoima rock quarry.

SPOKANE, WASH.—In order to insure a more absolute continuity of power, the Washington Water Power Company is installing a storage battery, adjoining the new Post street sub-station, which will be one of the most expensive and modern improvements made by the company. The battery will be in operation before next winter.

COMPTON, CAL.—The City Council has passed an ordinance granting to the Consolidated Utilities Company, the right to construct and for a period of 30 years, operate and maintain poles and wires and other apparatus for use in furnishing electrical energy for lighting, heating and power purposes over the streets and highways of this city.

SANTA FE, N. M.—The County Commissioners of Taos County have granted to the Rio Lucero Power Company, of

which Territorial Coal Oil Inspector Malaquias Martinez is president, a franchise giving the company the right to extend its line and transmit power throughout the county. The company will furnish electric light to Taos and neighboring points.

TACOMA, WASH.—Nome advices state that Scotch capitalists have purchased the Nome electric light and power plant owned by the John J. Sesnon Company. The plant was taken over in November and placed under the new management, with Arthur Gibson in charge. The purchasers are represented in Nome by Stuart Weatherly and Fox Ramsey, who have incorporated the Seward Peninsula Power Company and who intended this year to furnish power for mining purposes and lights for Nome and other Seward peninsula mining camps. A new plant will be built on the sand spit west of Snake river. Turbine engines will generate the power which will be transmitted by pole lines and cables. These will be extended many miles to creeks and beach lines where the power will be used for hoisting purposes and dredging. The pole line will be run to Solomon, 40 miles distant.

TACOMA, WASH.—The first lumber mill on the Pacific Coast to be equipped throughout with electric motor drive is now being built at Union Mills near Lacey, twenty miles west of Tacoma by the Union Lumber Company. The entire equipment for this mill, both the electrical and saw mill machinery is being furnished by the Allis-Chalmers Company. Current will be generated by a 750 k. w., 480 volt, 60 cycle, 3 phase, 3600 r. p. m. alternator directly connected to a steam turbine which receives steam at 150 lbs. pressure and discharges into a vacuum of 26 inches. Excitation is usually furnished by a 15 k. w. motor generator exciter set. A 35 k. w., 120 volt, direct current generator is directly connected to a 9 in. x 9 in. vertical engine and will furnish direct current for lighting and excitation when the turbo generator is being started. A two-panel switchboard is provided.

ILLUMINATION.

FOREST GROVE, ORE.—Hans Peterson, of Forest Grove has decided to install a light and water plant here.

BRANDON, ORE.—The Brandon Light & Power Company is making plans to double its equipment and install new lamps.

BANNING, CAL.—An election will be held here soon to vote on the question of establishing and maintaining a system of street lighting.

POMONA, CAL.—An artistic lighting system for the business section of the city is under consideration by the Business Men's Association.

PASADENA, CAL.—The City Council's request of the city light superintendent to purchase supplies to the amount of $1336.30 has been allowed.

TACOMA, WASH.—The Cameron Electric Company has been awarded the contract for furnishing Tacoma with $25,000 worth of electric lamps.

COQUILLE, ORE.—Bids will be received up to March 2, for installing a steam heating plant, etc., in the court house. Plans prepared by E. G. Perham.

FLORENCE, ORE.—T. J. Monroe of Coos Bay has applied to the City Council of Florence for a franchise to build and operate an electric light plant there.

THE DALLES, ORE.—J. D. Wilcox of Portland has been granted a 30-year franchise to conduct a gas plant here. Construction is to begin in the near future.

EVERETT, WASH.—The Everett Gas and the Snohomish Gas Works have been purchased by the Tacoma Gas Company. Extensions and improvements will be made in both plants.

PORTLAND, ORE.—It has been decided by the Alder Street Improvement Association to place cluster lights on the curb for the entire length of the street.

POMONA, CAL.—A committee composed of representative business men has completed plans for extensive improvements in the lighting system of Pomona.

DIXIE, IDAHO.—S. R. Gayton of Philadelphia, identified with the Penn-Dixie Mining Company, has purchased the Dixie townsite and will install an electric plant this summer.

BANDON, ORE.—The Bandon Light & Power Company, owner of the electric light plant of this city, is making preparations to enlarge the service to about double the present capacity.

FULLERTON, CAL.—J. R. Carhart and G. C. Ivy have purchased practically all of the stock of the Home Gas Company, of this city, for about $18,000. They will make a number of improvements and install new machinery.

SIERRA MADRE, CAL.—The City Clerk is receiving sealed bids for a gas franchise in this city. The franchise is good for 50 years and includes the right to construct underground conduits, mains and gas pipes in public streets.

CITY OF MEXICO, MEX.—F. W. Walser of Cleveland, O., president of the A. & W. Sign Co., is expected here next week for a conference with the centennial officials relative to the lighting of the city during the centennial celebration this fall.

LOS ANGELES, CAL.—The Trustees of Hermosa Beach have closed a contract with the Edison Company for the installation of arc lights on all thoroughfares where street work is in progress, which calls for an expenditure of more than $250,000.

EUGENE, ORE.—John Hunzicker, the architect and superintendent for the new Osburn hotel, is arranging plans for an independent light and power plant to be installed in the basement of the hotel to supply light for the house and power for the elevator.

ALHAMBRA, CAL.—The Board of Trustees is receiving bids for furnishing ornamental cast iron posts to be equipped with incandescent electric lamps, and necessary wires, connections and fixtures for lighting Main street between the center line of Third and the center line of Monterey.

SEATTLE, WASH.—Sealed proposals are being received by C. B. Bagley, secretary of the Board of Public Works, for the installation of a complete system of cluster lights along Broadway and North Broadway, from the north line of East Pike street to the south line of East Roy street.

GLENDALE, CAL.—The distribution of gas pipes along one of the main streets by the Domestic Gas Company of Los Angeles and the report that it will lay mains through three principal streets with laterals to all parts of the city, are the latest developments in the lighting situation here.

SANTA BARBARA, CAL.—It is given out that as a result of a conference between the directors of the Edison Company and the Mayor and Council the company will spend $211,000 for a new gas plant four times the size of the present one. About $150,000 more will be devoted to the extension and improvement of the local trolley system.

PHOENIX, ARIZ.—On February 24th an election will be held in this city for the purpose of determining whether or not the Common Council shall apply to Congress for authority to issue bonds of this city in a sum not exceeding $300,000, for the purpose of constructing, or acquiring by purchase, an electric light, gas and power plant for supplying this city.

SANTA BARBARA, CAL.—The City Clerk is receiving sealed bids for 172 arc lights known as 2000 candlepower and 42 incandescent lights of 16 candlepower to be located where the same are now located, and for such additional

lights as the city may from time to time order, in such places as may be determined and under the same conditions in the contract of the city with the Edison Electric Company.

SEATTLE, WASH.—Sealed proposals are being received for the installation of a complete system of cluster lights along Union street, along Hubbell Way, Pike street, Fourth avenue, Fifth, Sixth, Seventh, Eighth and Ninth avenues, Terry, Bordon, Minor and Melrose avenues, Bellevue, Summit, Belmont, Boylston and Harvard avenues.

SEATTLE, WASH.—The Seattle Lighting Company, of which S. R. Hutchinson is superintendent, will make Georgetown the distributing point for the whole south end district by laying over five miles of new mains; $125,000 to be expended. A steel gas holder with a capacity of 1,000,000 cubic feet has been ordered. A two-story brick and cement office building will be erected.

REDLANDS, CAL.—H. B. Duncan, secretary of the San Bernardino Valley Gas Company, states that the company will construct a generating plant at Colton and manufacture gas to be used in Colton and Redlands. Should it be advisable the company will construct a high-pressure line from Colton to Corona, but the natural course will be from Colton to Highgrove, through Riverside and Arlington, and from Arlington to Corona.

ELLENSBURG, ORE.—The electric light committee of the City Council and the superintendent of the municipal plant have formulated plans for the improvement of the present plant, located on the Yakima river two miles west of the city. They will install a steam auxiliary plant and enlarge the power canal carrying water from the river into the turbine. No definite action will be taken on the power canal improvements until a city engineer is appointed.

LAS CRUCES, N. M.—It is announced that the purchase of the Las Cruces Electric Light & Ice Company is pending and that the holdings of the local company would be taken over by an eastern concern providing a franchise can be obtained. J. B. Downey, representing eastern capitalists, arrived here recently and has assumed active management of the company's plant. G. W. Morgan will arrive in a few days and will be permanent manager if the deal goes through.

TRANSPORTATION.

MONTESANO, WASH.—The Grays Harbor Interurban Company has applied for a franchise for the construction and operation of a line of interurban railway over county roads in Chehalis county.

GUADALAJARA, MEX.—The Chapala Hydroelectric and Irrigation Company is now considering the construction of an electric railroad from Guadalajara to Aguascalientes. No definite steps have been taken.

LOS ANGELES, CAL.—A petition for offering for sale of a franchise for a trolley line on South Park avenue over the route rejected at the last election has been referred to the public utilities commission.

SPOKANE, WASH.—Big Bend Transit Company expects to begin construction in the spring of an electric road from the mouth of Spokane river to this city, according to the announcement of W. A. Nichols.

BERKELEY, CAL.—Attorney M. R. Jones, representing the East Shore and Suburban Railway Company, has filed an application with the Albany Trustees asking for a franchise for an electric street car line. The company is to operate lines from Point Richmond and through Albany as follows: South along San Pablo avenue, thence west and south to connect with the northern end of the S. P. loop extending out from Berkeley. The franchise, if granted, will link Richmond, Stege, San Pablo, Rust and Point Richmond with the S. P. electric system, connecting with San Francisco, and will fill in the last remaining gap in the bay cities on this side.

WATERWORKS.

DORRIS, CAL.—The Trustees are negotiating with the United Iron Works of Oakland for a system of waterworks.

VALLEJO, CAL.—The Board of Public Works has decided not to purchase 500 water meters for the use of water consumers in this city.

SACRAMENTO, CAL.—City Engineer Randle has recommended that 1040 feet of wrought iron water pipe be purchased for the South Side Park.

SEATTLE, WASH.—The City Council has passed a number of ordinances and resolutions preparatory to the laying of water mains in a large number of streets.

PORTLAND, ORE.—Sealed proposals will be received at the office of the City Clerk until 10 o'clock a. m., February 15th for the furnishing of all material and labor for the construction and completion of a city waterworks system.

REDLANDS, CAL.—Steps have been taken to organize a new water company of the Crafton Heights ranchers and to rebuild a pipe line washed out several years ago by a flood. A survey just completed, shows that the work will cost $20,000.

EL CENTRO, CAL.—The City Council has passed a resolution determining that public necessity demands the acquisition, construction and completion of a municipal waterworks and water system and that bonds will have to be issued for said improvement.

VALLEJO, CAL.—Authority having been received from the Board of City Trustees, City Clerk Tormey has been authorized to advertise for 2000 feet of 4-inch pipe and six fire hydrants which are to be used in improving the fire protection system in the northern section of the city.

PHOENIX, ARIZ.—Bids have been opened by the Board of Control for the construction of water tanks at the territorial prison. There were six bidders ranging in amount from $6000 to $2800, though the latter bid was only for material. The award was tentatively made to Des Moines Bridge & Iron Works, at $3495.

CALEXICO, CAL.—The Board of City Trustees have opened bids as follows for the new municipal water system: Fairbanks-Morse Co. of Los Angeles, $13,675; Harper Reynolds Co., Los Angeles, $15,180; Crane Co., Los Angeles, conditional bid, $13,550; R. H. Boyton Co., Memphis, Tenn., $13,175.75. The last named bids will be accepted.

CENTRAL POINT, ORE.—Sealed proposals will be rereived by the town recorder of Central Point, Ore., until February 15, 1910, for constructing waterworks, work to consist of hauling and laying steel pipe, valves, valve boxes, hydrants, special castings, pump, motor and water tower for a distributing pipe system, all labor and material to be furnished by the contractor.

PORTLAND, ORE.—Plans and specifications for the proposed new pipe line from Bull Run to Portland have been completed by Engineer Clarke of the City Water Department. According to Mayor Simon, bids will be asked for building this aqueduct, and the contract let within the next few weeks. The new line will paralel the one now in use and will have a capacity of 40,000,000 gallons daily.

BAKER CITY, ORE.—An ordinance has been passed instructing the city engineer to prepare estimates of the cost of improving the upper pipe line by replacing the 8.11 miles of flume with a substantial pipe, the building of a parallel line from the settling tank to the city reservoir, and the construction of a twin reservoir near the present one. When the estimates have been made, the question of voting bonds for the improvement will be submitted to the taxpayers.